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PUBLIC UTILITY VALUATION

REPRODUCTION COST AS A BASIS FOR DEPRECIATION AND RATE-BASE DETERMINATION

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REPRODUCTION COST AS A BASIS FOR DEPRECIATION AND RATE-BASE DETERMINATION

A DISSERTATION SUBMITTED TO THE FACULTY
OF THE SCHOOL OF BUSINESS IN CANDIDACY
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

1934

By
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CHAPTER I

RATE-BASE DETERMINATION

For over twenty-five years privately owned public utilities have been subject to a substantial degree of regulation by state and federal governmental agencies. These businesses, "affected with a public interest," are recognized as unique in character; before a special tribunal the consumer has equal opportunity with the company to present his side of disputed questions. Such regulation is based partly on the theory that "utilities" are essentially monopolistic in character and therefore cannot operate satisfactorily under competitive conditions, and partly on their close connection with the protection of life, health, and property.[1] The scope of regulation has expanded continuously until at the present time about one-fifth of the total productive national wealth is included.[2]

Many diverse functions are exercised by regulatory bodies. One author submits a list of more than a dozen such functions relating to all classes of utilities.[3] The present discussion relates only to "rate making."

The problem of rate making.—The determination of a scale of service rates is the final step in a procedure which may be outlined somewhat as follows:

1. Determination of property items to be included in rate base.
2. "Valuation" of each of these items and the determination of the total amount of the rate base.

[1] The basis of utility regulation was stated by the Supreme Court of the United States in *Munn* v. *Illinois*, 94 U.S. Rep. 113, as follows:

"Under the powers inherent in every sovereignty, a government may regulate the conduct of its citizens toward each other and, when necessary for the public good, the manner in which each shall use his own property.

. . . . "When the owner of property devotes it to a use in which the public has an interest, he in effect grants to the public an interest in such use, and must to the extent of that interest, submit to be controlled by the public, for the common good, as long as he maintains the use. He may withdraw his grant by discontinuing the use."

[2] This estimate, based on United States Census figures of total national wealth, does not include the productive wealth now subject to a degree of regulation under the N.R.A., A.A.A., etc.

[3] W. A. Prendergast, *Public Utilities and the People* (New York, 1933), pp. 11–12.

3. Determination of a "fair" rate of return to be applied to the amount of the rate base.
4. Estimate of probable operating expenses, including depreciation, for period involved.
5. Estimate of probable business volume at various proposed service rates, and the gross income thereby possible.
6. Establishment of a service rate (or scale of rates) that is designed to produce a gross income sufficient to cover all operating expenses, including depreciation, and to yield a "fair" return on the amount of the rate base (as determined above).

Major problems are encountered at every step in the procedure described above. The scope of the present discussion is limited to a consideration of the problems arising in (2) and (4) above, the "valuation" of the items included in the rate base, and the determination of the annual charge for depreciation.

"Valuation" for purposes of rate-making.—For many years the subject of "valuation" of public utility properties for purposes of rate-making has been discussed frequently, at great length, and from many different points of view. Much of the discussion has been based on what has actually been done by the commissions and by the courts—analyses and interpretations of their rulings and their decisions, and a justification or a condemnation of them. Considerable attention has been directed to underlying principles of justice and equity, both to investors and to consumers. From time to time economic laws and principles have been summoned to support one or the other of several alternative bases of utility property "valuation" for rate-making.[4] But in spite of thousands of commission and court decisions, hundreds of articles and speeches, and dozens of books, all relating to various aspects of utility "valuation," the problem is still far from final solution.

The present discussion.—It is the purpose of this discussion to present an analysis of the relative advantages and disadvantages of the alternative bases and methods of "valuation" for rate-making purposes, from as many points of view as possible, reflecting, in so far as possible, the probable effects of each method on the interests of investors and of consumers. The acts, decisions, and rulings of legisla-

[4] The "facts" of the case in hand have opened the way for decisions "which have both approved and disapproved of every major economic theory of valuation which has yet been advanced." (See F. K. Beutel, "Valuation as a Requirement of Due Process of Law in Rate Cases" *Harvard Law Review*, XLIII, 1,262.)

tures, commissions, and courts are here given only secondary consideration, under the assumption that if any one basis of "valuation" is most desirable, in terms of predictable results, any changes in existing laws and precedents that are necessary to establish that basis, (including, conceivably, amendments to the Constitution of the United States) can in time be brought about. Some evidence that such sweeping changes are not entirely impossible is indicated in the recent tendency toward accomplishing, by direct legislation of a very unusual nature, any objective deemed desirable from a broad social point of view—that of "the greatest good to the greatest number."

Inapplicability of the term "value."—The principal bone of contention in this particular "valuation" problem is the concept of "value" for purposes of the rate base. It is suggested that the use of the term "value" in this connection be completely outlawed, on the grounds that any usual meaning of the word is strictly inapplicable. In the final analysis, the objective in view in a public utility "valuation" problem is the determination of the amount of allowable earnings and the establishing of service rates that will secure these earnings; but the earnings *determine* the "value," in the economic sense, of the properties "used and useful" in producing these earnings. Thus it is impossible to arrive first at the "value" of properties, and then to allow such "value" to be the principal factor in determining the allowable earnings of these same properties which, in turn, determine their value. To avoid this circular reasoning, it is suggested that the problem be considered not as "valuation," but as the determination of the amount of a "rate base." This term implies no confusing concept of "value," and we are left free to select any method of determining the rate base which, from the many conflicting points of view involved, appears to be more equitable and more practicable than any other available method. Thus the problem of "valuation" of public-utility properties becomes rather a matter of evolving a method or a basis for the computation of the amount upon which the utility shall be allowed to earn a "fair return."[5]

[5] Theoretically, the amount of the rate base and the "fair rate" of return are determined independently of one another. Actually, the degree of risk placed on the investor by the selection of a given basis for determination of the rate base influences the decision as to what constitutes a fair rate of return. However, this apparently simple relationship between rate base and rate of return is seriously disturbed by a confusion in the concept of "risk"—risk in dollars versus risk in terms of "real" income. This point is discussed at somewhat greater length on subsequent pages.

Unprofitable enterprises.—A study of public-utility operating statements reveals the fact that not always is there a net profit, before interest and dividends, equal to a "fair return" on the rate base. In times of general business depression this may be due to decreased volume,[6] or to an inability to adjust service rates rapidly enough to conform to changing conditions, and for most companies it is only a temporary situation. In other cases, however, it may be an impossibility ever to set rates high enough to yield an income sufficient to pay expenses and net a "fair return." In other words, in any given situation there is a maximum service rate, or schedule of rates, which represents all that "the traffic will bear," and if sufficient business cannot be secured at these rates (or at lower rates) to enable the company to operate at a "fair" profit, there is no possible assistance to be rendered through "regulation." The choice of a basis for rate-base determination is, in such a case, purely an academic problem. The whole problem in this situation is one of so adjusting rates to corresponding demands for service that the maximum net income is received, whether or not it represents a "fair return." It is only when such maximum income is more than a "fair return" on *some* rate base that the basis for determination of the rate base becomes a practical problem. For example, it is almost certainly true that during the past few years very few railroads were able to earn a "fair return" on any reasonable rate base; therefore the problem of rate-base determination has, in their case, received relatively little attention. For most utilities, however, it is an important problem most of the time.

Original versus reproduction cost.—Various methods and bases for the determination of the amount of the rate base have been suggested.[7]

[6] Service rates should probably be set to earn a "fair" return under a normal or average volume of business. A greater volume than the normal (or average) would then make possible the creation of a surplus out of which to maintain the regular dividend rate when the volume is below normal. Such a plan presupposes, perhaps, too great a facility in predicting future volume cycles.

[7] There are ten commonly used measures of value which can be divided into two equal groups; the first relating to the value of the property at the time of its construction, and the second to the value of the property at the time that the valuation is made. In the first group we have (1) original cost, (2) historical cost, (3) book cost, (4) investment cost or outstanding capitalization, (5) prudent investment cost. . . . . In the second group we have (6) reproduction cost value, (7) split inventory value, (8) taxation value, (9) market value, (10) purchase value. See F. X. Welch, *Cases on Public Utility Valuation* (Washington, D.C.: Public Utility Reports, Inc.), p. 411.

Practically all of them, however, are only variations of one or the other of two fundamental, and directly conflicting bases—the original (historical) cost, as against the reproduction (present) cost, of the specific properties "used and useful" in the operation of the business and therefore to be included in a base for determining allowable earnings.

Definition of original cost.—Literally, original cost is the total amount (in dollars) that has been expended by the utility at one time or another in the construction or acquisition of the properties which are at the time of the inquiry included in the rate base as being "used and useful" in the operation of the business.[8] This amount is readily determinable from the books of account, if they have been properly kept since the founding of the business. In the absence of proper records it is often necessary to substitute an estimate of what the cost of the properties should have been at the date of their acquisition. Likewise, where funds have been expended on grossly ill-conceived projects, or where securities of doubtful value have been issued for properties, the doctrine of "prudent investment" has been injected to refine the concept of original cost so that it describes an amount which might "reasonably," by a "competent and prudent person," have been expended on these properties at the time of their acquisition. So universal has been the acceptance of this doctrine of prudent investment that it is generally assumed to be an integral part of the original cost basis of rate-base determination.

Definition of reproduction cost.—Reproduction cost, in the usually accepted meaning of the term, is the amount (in dollars) that would have to be expended now (the date of the inquiry) in the construction or acquisition (new) of the properties included in the rate base—a *present* cost instead of a *past* cost figure.[9] In practice this amount is ordinarily determined by engineers' appraisal, including, too infrequently, a recomputation of the original cost records and substitution therein of present labor, material, and overhead costs for those actually incurred. Because of the alleged inexactness and expensiveness of these processes an alternative method has been suggested, namely, that index numbers be applied to the original cost figures (subject to the doctrine of prudent investment) preferably a special index of public-utility

[8] Discussion of the amount of accrued depreciation to be deducted from this total original cost, or from reproduction cost, for rate base purposes, is deferred to later chapters.

[9] See n. 8.

construction costs,[10] thereby arriving at an approximate reproduction cost figure.

A variation of reproduction cost often found in practice is the use of the *average* costs for a specific period of time, perhaps the five-year period just ended, instead of the cost as of the date of the inquiry.[11] This method ordinarily constitutes a compromise between original and reproduction costs. Probably the principal reason for its use is the fact that under present methods of rate-making, changes in the rate base are made infrequently, and an *average* reproduction cost figure will therefore be more applicable to the period to be affected—perhaps the next several years. If changes in the rate base could be made frequently, without delay, and inexpensively (as suggested under the index number method on pp. 21 ff.) there would seem to be no logical reason for the use of average cost rather than the reproduction cost at the date of the inquiry.

Another variation, also a compromise, is the use of the so-called "split inventory" method developed by commissions during the war period.[12] It was frequently suggested then that all properties acquired before a given date (known as the splitting date) should be included in the rate base at their cost of reproduction as of that date, while properties acquired subsequent to that time should be included at original cost. This principle is reflected in recent suggestions that reproduction cost be applied to all properties now existing, but that the original cost basis should govern thereafter.

Still another variation of reproduction costs gives effect to probable future costs and price levels. "The value is being fixed, not for today, but for a reasonable period in the future."[13] "An honest and intelligent forecast of possible future values made upon a view of all relevant circumstances, is essential."[14] But perhaps the best evidence of probable

[10] See pp. 21 ff. for a discussion of index numbers.

[11] The ruling of the Commission in *McCardle* v. *Indianapolis Water Co.*, 272 U.S. 409, illustrates the application of this method.

[12] For an excellent discussion of the "split inventory" method see E. M. Bernstein, "The Split Inventory: A War Expedient, a Solution in Peace," *Quarterly Journal of Economics*, XLIV, 493–522.

[13] *McCardle* v. *Indianapolis Water Co.*, 272 U.S. 400.

[14] *Missouri ex. rel. Southwestern Bell Telephone Co.* v. *Missouri Commission*, 262 U.S. 276.

future prices is the present existing price, for "the inability of economists to predict the future trend of prices has been definitely established.[15]

Reproduction-cost-of-service.—At various times there have been very determined but generally unsuccessful attempts to define reproduction cost as the estimated present cost of the most efficient plant that could now be constructed for performing the service in question—a reproduction-cost-of-service theory. From many standpoints this would be an ideal basis of rate-base determination, for it would introduce a distinct incentive to efficient operation. By penalizing for obsolescence and inadequacy, it would encourage proper construction, would induce the choice of the best alternative methods of production, and would almost certainly reduce the production cost per unit of service rendered. In many respects it most nearly approximates the situation as it would be under unrestricted competition. It is believed, however, that it would be impossible to secure even substantial agreement, in a given situation, as to what constitutes the most efficient plant. Too many uncertainties are added to the situation; to questions of alternative prices and costs and conflicting opinions on amount of accrued depreciation there is added the problem of choosing between alternative physical assets. Adjustments must be made for any probable differential between the actual operating costs of the existing plant and the estimated operating costs of the hypothetical "most efficient" plant. Experts and still more experts would be required, all to be paid with taxpayers' (or consumers') money. The costs, delays, uncertainties, and disagreements that would surely result from any attempt to apply such a basis would more than offset any advantages which, in theory, it possesses. There seems to be almost universal agreement on this point.[16] It does seem desirable, however, to leave open the possibility of applying some such principle in cases where the existing plant is almost wholly obsolete and methods of production are grossly inefficient. Particularly in the case of electric light and power has the development been so rapid that many plants and a large amount of equipment should be scrapped,

[15] Milo R. Maltbie, Chairman of New York Public Utility Commission, in review of *Washington Heights Taxpayers Association* v. *N.Y. Edison Company.* P.U.R. 1932 E 218.

[16] However, a very able defense of the reproduction-cost-of-service basis has been written by H. G. Brown, *Journal of Political Economy*, XXXIII, 505–30.

or their use penalized by the application of the reproduction-cost-of service principle.[17]

Points of view to be considered.—The problem of rate-base determination must be analyzed from several points of view, primarily those of the consumer of utility services, and of the various classes of investors in utility securities. It must be recognized, of course, that there is a great amount of "interlocking" between the "investor" group and the "consumer" group, for millions of persons and thousands of businesses are both investors in and customers of utilities. These same parties may at the same time have still a third and different point of view, that of taxpayers contributing to the costs arising from the administration of public-utility regulation.

The "public," then, in its relation to utilities, represents a very complex concept, for of course there are no special "public" interests apart from individual interests. There are millions of investors in public-utility securities, and many more millions of taxpayers and consumers of utility services. In popular parlance, however, the "public" is made up of consumers and taxpayers[18]—not investors—in any conflict of interests between the "utilities" and the "public."

[17] One can argue, of course, that business men in competitive industry are forced to make estimates, computations, and decisions similar to those required for a utility under the reproduction-cost-of-service basis of rate-base determination. This is substantially true, and competitive prices are thereby determined. But the introduction of "expert" engineers, accountants, appraisers, and lawyers for the utility, and a similar group of "experts" for the commission, with a possibility of review by one or more courts, complicates to a considerable extent an otherwise relatively simple problem. It is repeated that for public utilities the delays, uncertainties, disagreements, and expense of this method more than offset its advantages.

[18] This point of view may be modified as public utility securities are still more widely distributed. In the agitation following the "dissolution of the Insull Empire," for example, it could almost be said that the "public" had the investor point of view.

CHAPTER II

THE INVESTOR POINT OF VIEW

Present versus new investors.—In discussing the subject of rate-base determination from the standpoint of "fairness" to investors it must be recognized that only present investors need be considered, and that they merit consideration solely because of the *ex post facto* nature of any changes to be made in regulatory policy subsequent to their investment. New investors (those entering the situation after definite policies have been determined and announced) are free agents who knowingly and willingly choose to invest their funds under the new regulations, and who have the opportunity of selecting the degree of stability or of speculative possibility which they desire. Therefore, consideration of new investors involves not "fairness," but the adoption of regulatory policies that will make possible attractive utility investments—investments that will meet with the approval of the investing public and which will, therefore, tend to enable the utility to secure its necessary capital promptly and economically at any time. The blue sky laws of the various states and the Federal Securities Act should provide for investors in public-utility companies, as for other investors, all the "protection" to which they are entitled.

Fairness to present investors.—To present investors, however, certain "public" commitments have been made. They have invested their funds with the expectation that a type of regulation similar to that which has existed will govern in the future. Any changes made in regulatory policy now would be *ex post facto* as far as they are concerned. Therefore, in so far as it is possible to determine the terms of their rather indefinite and intangible "contract," any substantial changes in regulatory policy must be adopted only when provisions are included for the benefit of present investors that approximate as nearly as possible what they could "reasonably" expect.

Unfortunately, there is not complete agreement as to what constitutes a "reasonable" expectation under this "contract." Present holders of utility securities may have made their purchases during the predominance of any one of several regulatory policies. It is probably true, however, that these securities are valued at present under the expecta-

tion that the reproduction-cost basis will be the ruling principle in rate-base determination, for the trend of commission rulings and court decisions has been distinctly in that direction. The principal cases supporting reproduction cost as a basis of rate-base determination are those listed below.[1]

It would seem, therefore, that any radical departure from that basis, for purposes of *initial* statement, at least, would not be in strict accordance with the "public" commitment to present investors. This fact explains the "concession" made by many original-cost advocates to the effect that existing properties should at the present time, perhaps, be included in the rate base at reproduction costs, for even they believe that less injustice would be done to present investors by the adoption of this basis than any other, solely because this has been the more usual basis for several years, in most jurisdictions, and most investors have purchased (or held) their securities under the presumption that a similar policy would obtain in the future (insofar as investors rationalize on this phase of their investments).

New investors.—With respect to new investors in public-utility securities there is no special responsibility that does not exist in competitive business. The major problem in their case is to adopt a basis of rate-base determination that will tend to insure a favorable market for public-utility securities; that is, a basis that will create the type of utility investments desired by new investors. Each basis must be analyzed in terms of its probable effect on this market. From this standpoint the factors to be considered are these: (1) degree of risk of loss of capital, (2) stability of earnings, (3) stability *vs.* speculative possibility, (4) stability in dollars *vs.* stability in real income, (5) stability of dividends (through reserves or surplus).

"Conservative" investments.—It is obvious that an original-cost basis tends to create a "conservative" investment—conservative in the sense that the *dollar* return to investors is relatively unchanged during peri-

[1] *Smith* v. *Ames*, 169 U.S. 466; *Wilcox* v. *Consolidated Gas Co.*, 212 U.S. 19, 52, 53; *Missouri ex rel. Southwestern Bell Telephone Co.* v. *Missouri Commission*, 262 U.S. 276; *Bluefield Water Works & Improvement Co.* v. *West Virginia Public Service Commission*, 262 U.S. 679; *McCardle* v. *Indianapolis Water Company*, 272 U.S. 400; *St. Louis & O'Fallon Railway Company* v. *United States*, 279 U.S. 461; *United Railways and Electric Company of Baltimore* v. *Public Service Commission of Maryland*, 280 U.S. 234; *Denver Union Stock Yard Company* v. *United States*, 57 F, 2d, 735; *Los Angeles Gas and Electric Corporation* v. *California Railroad Commission*, 58 F, 2d, 256.

ods of specific or general price-level changes.[2] If the assumption be made that adjustments in service rates required by changes in operating costs can be made more promptly and accurately than has been true, even common stocks of "sound" utilities would be "conservative" investments under an original cost basis. In fact, if the "allowed" rate of return be currently adjusted to conform to changing interest rates, it is conceivable that the market prices of such common stocks would fluctuate less widely than those of the bonds and preferred stocks of the same companies, for the return on these last-named types of security is fixed and not adjustable to changes in "going" interest rates.[3] The conclusion is apparent: The "variety" of investments which utilities can offer is reduced. Only "conservative" funds would be available for sound public-utility investments. No "speculative" funds would be attracted to the utility field, except to less well-established companies in which the uncertainty of profitable operation would necessitate higher rates and thereby attract "speculative" funds.

"Real" versus "money" income.—It is probably less necessary now than ever before to point out to the reader that the "stability" and "uniformity" of return described above are more apparent than real. Recent price-level changes, and the passage of important legislation designed specifically to force general price-level increases, have resulted in a general appreciation of the important relationship existing between price levels and real income as distinguished from money income. Actually, from the standpoint of a protected real income, adherence to the original cost basis *creates* a risk for the utility common stockholders which is not inherent in other common-stock investments—the risk of loss through the changing purchasing power of a constant dollar return.

"Stability" in real income.—The reproduction-cost basis offers to potential investors bonds and preferred stocks with the same fixed dollar return as under original costs but with a slightly decreased safety factor

[2] The accuracy of this statement is subject to the possibility of fluctuating volume and its effect on earnings, independent of price level changes. Also a policy of uniform dividends (in dollars) despite fluctuating earnings would demand some qualification. It is true, however, that the return to investors (in dollars) would fluctuate *less* under an original cost basis than under reproduction costs.

[3] Even under these conditions a "narrow" equity of common stock may be subject to fluctuating market prices caused by the "cumulative" or "multiple" effect of changes in the rate of return as applied to the whole rate base. See pp. 12–13 ff.

so far as ultimate safety (also in dollars)[4] is concerned. Under reproduction costs, however, common stocks may yield a widely fluctuating return, the nature and extent of the fluctuation depending upon two factors: (*a*) price changes, and (*b*) the percentage of total capital secured on a fixed return basis (bonds and preferred stock).

The position of the common stock under a reproduction-cost basis is rather complicated. Where the entire capital is secured by a single common-stock issue, and there are no (or relatively small) fixed-return obligations, the dollar return on the common stock will tend to follow price-level changes. It thereby holds relatively constant in real income, and thus provides for a more real stability of earnings than would a uniform dollar return.[5]

"*Speculative*" *investments.*—Under actual conditions, however, the greater part of utility capital is usually secured by the issue of bonds and preferred stock, the average of these fixed return obligations being from 60 per cent to 75 per cent of the total capital secured.[6] Unless adjustment is made in the rate base only in proportion to the common-stock equity, such a condition greatly increases the speculative nature

[4] It can readily be demonstrated that the so-called decrease in the safety factor of bonds and preferred stock which is mentioned here is in terms of dollars only and not in terms of purchasing power. Let us assume a capitalization of 35 per cent bonds, 30 per cent preferred stock, and 35 per cent common stock. What if the common-stock equity of 35 per cent is more than completely wiped out by a price decline of 40 per cent, and the position of the 30 per cent preferred stock endangered? The equity of preferred has been reduced $\frac{5}{30}$ or $16\frac{2}{3}$ per cent. But price levels are down 40 per cent. The purchasing power of the preferred stock equity is really increased 39 per cent ($83\frac{1}{3}$ per cent $\times$ $166\frac{2}{3}$ per cent) and that of the bonds increased $66\frac{2}{3}$ per cent.

[5] It has been suggested at various times that investor real income could be better protected by modifying the rate of return rather than by adjusting the rate base. However, the problem of determining the amount of the rate base still remains, and whether the desired increase or decrease in return should be secured by a change in the rate or a change in the base seems relatively unimportant. Another suggestion of the same type is that the item "going value" be varied to adjust for changes in reproduction cost.

[6] It has been stated by Justice Brandeis (*Southwestern Telephone Co.* vs. *Public Service Commission*, 262 U.S. 276 (307) and by Bauer (*Public Utility Fortnightly*, May 5, 1929, p. 507) that about 75 per cent of public-utility capital has been secured on a fixed-return basis. On the other hand Mosher and Crawford in *Public Utility Regulation*, p. 182, state that ". . . . the senior securities normally constitute from one-half to three-fourths of the total claimed investment."

of the common stock. Any change in the rate base, and consequently in the amount of return, is reflected wholly in common-stock earnings. To common stockholders, therefore, the effect of such a change may be multiplied many times.[7] For example, if only 25 per cent of the total capital has been furnished through common stock and surplus, a 10 per cent increase in the rate base (with no change in the *rate* of return) will increase common-stock earnings by about 40 per cent. Conversely, a decline of 25 per cent or more in the rate base (and in allowed earnings) may completely eliminate the earnings on the common stock. Such a decline is likely to result in the "failure" of the utility company; a careful analysis, however, reveals that it is a "failure" only in the sense that certain equities (principally those of common stockholders) disappear. It may decrease the dollar equity of the preferred stockholders, or even of the bondholders, and it may demand a reorganization. In another sense, however, it need not be a "failure" in so far as the real worth or earning power of the property is concerned, and there is no good reason why the service must suffer. Cash income may still exceed cash outgo, for this would be independent of the relative earnings of the various securities. After the reorganization the bondholders and the preferred stockholders may own the company, or an entirely new capital plan may result, but the total purchasing power value of the properties does not necessarily decline and the company can, and in many cases will, continue the service practically uninterrupted by the "exit" of the common stockholder.[8]

A somewhat different approach can be made to the problem of the narrow equity of the utility common stock and its consequent highly

[7] The "multiplier" is determined by dividing the total rate base by the amount of common stock and surplus, a method approximately equivalent to inverting the fraction representing the proportional equity of common stock in the total capitalization. If the operating company is owned by a holding company which secures part of its own capital on a fixed-return basis, the effect to holding company common stockholders of a change in the rate base of the operating company is, of course, subject to a second "multiplier," similarly determined.

[8] The common stockholders of competitive enterprises are always subject to just this type of risk. The trend of selling prices of products and services generally tends to correspond to changes in the present rather than the original costs of production. Therefore no extra risk is placed on the public-utility common stockholder by the use of the reproduction cost basis of rate-base determination that is not borne by other types of common stockholders. The risk is magnified, of course, by the relatively narrow common-stock equity prevailing in public-utility capitalization.

speculative character under a reproduction-cost basis of rate-base determination. If such a situation be unsatisfactory, if capital cannot be secured under such highly speculative conditions, it may be an indictment of the narrow common-stock equity rather than of the reproduction-cost basis of rate-base determination. It is certainly true that a larger proportionate common-stock ownership would moderate materially the highly speculative nature of this type of investment and would at the same time tend to restore any loss of the (dollar) stability of preferred stock and bonds. It is very obvious that new capital must be secured through the issue of the kind of investment securities that investors will buy; therefore, types of securities will be altered, when and where necessary, to meet the demands of the investing public. If the result is a gradual widening of the common-stock equity—and a consequent reduction of the highly speculative qualities inherent in such a security under a reproduction-cost basis—one of the principal objections to this basis of rate-base determination will have been eliminated.[9]

Stability through reserves.—There is still another answer to the objection that the reproduction-cost basis of rate-base determination may cause extreme fluctuation in the earnings and market prices of public utility common stocks. *All profits need not be paid out in dividends.* A part of the high earnings of high-cost years may be used to create a

[9] There is still another method of eliminating the highly speculative nature of public-utility common stock, a method which will at the same time eliminate for "fixed" return investors the risk of changes in their real income. This plan contemplates that the return on bonds and preferred stock be "fixed" in terms of real income (based on index numbers) rather than in terms of dollars (money). Theoretically the idea is sound; if prices are going to continue to fluctuate as widely as they have in the past twenty years, probably all types of securities—in fact, all types of obligations to pay money—should be subject to adjustment according to index numbers, with respect to both principal and return. Practically, however, it will probably be easier to control prices and prevent fluctuations than to introduce such a radically different basis for our traditional "standard of deferred payments."

A constant dollar income to holders of bonds and preferred stocks and a relatively constant real income to common stockholders can be secured by still another plan—that of adjusting the rate base according to reproduction costs only to the extent of the common-stock (and surplus) equity in the rate base. The main objection to this procedure is that the consumer does not secure the full benefit of the reproduction-cost method. This objection will be better understood in the light of the discussion from the point of view of the consumer, to be found on subsequent pages.

reserve, and out of this reserve dividends can be paid in the low-cost years when earnings are low—thereby maintaining stability of dividends in spite of fluctuating earnings. Alternative proposals for various types of reserves include the following:

1. Maximum dividend rates for common stock
   a) Balance of earnings in high cost periods to be added to surplus
      (1) And added to the rate base, or
      (2) Excluded from the rate base (the Massachusetts rule)

(Furnishes a reserve for dividends out of surplus in "lean" years—low-cost periods)

2. Creation of a reserve (and withholding from dividends) of an amount equal to 50 per cent (or other percentage) of the amount of earnings due to use of the reproduction-cost basis rather than original costs, and withdrawals from this reserve for dividend purposes when earnings under reproduction costs are less than they would be under original costs.
3. A "recapture" by federal and/or state governments of all or a part of earnings in excess of a maximum dividend on common stock

All of these plans tend to reduce common-stock returns in high-cost periods and the first two would increase the return in low-cost periods. In so far as all amounts withheld from dividends are included in the rate base until needed to supplement low earnings in subsequent periods, such reserves are "fair" to investors and do furnish a stabilizing influence to common-stock returns and therefore to market prices. However, any plan to withhold an amount from dividends and exclude it from the rate base, or to "recapture" earnings in excess of a maximum dividend rate, is "unfair" to investors, and not at all in the spirit of the reproduction-cost principle, for there is no complete offsetting "benefit" when earnings are less than they would be under original costs. A "recapture" of earnings over and above a fair return on the rate base is an entirely different proposition, for this latter procedure serves to correct service rates inaccurately set at too high a figure. Even in this case, to secure complete justice, the amounts so recaptured should be used to supplement earnings in years when the service rates are mistakenly set at a figure too low to earn a fair return.

Incentive for good management.[10]—It is evident from the foregoing analysis that under the reproduction-cost basis of rate-base determina-

[10] Other devices designed to furnish incentives for efficient management are discussed on pp. 69–71 ff.

tion the common stockholder assumes very heavy risks of fluctuating returns, both in money and in purchasing power. From the standpoint of good business management there is one distinct advantage in this situation. Ordinarily common stock controls management, and management controls (within the limits of absolute minimum business requirements) the selection of periods for expansion and construction. Under the original-cost basis of rate-base determination there is small incentive to select low-cost periods for construction or to avoid high-cost periods; original cost determines the basis of return and little is to be gained or lost to the investor by constructing in one period rather than another.[11] The reproduction-cost basis, on the other hand, furnishes a real incentive for the use of sound business judgment in the matter of construction, expansion, and optional replacements. The choice of a low-cost period makes for higher returns to common stock, subsequently, when prices increase again, while an error of judgment, resulting in construction or expansion in a relative high-cost period, costs common stockholders heavily when the low-cost periods are reached again. Under reproduction costs, therefore, good business judgment is rewarded while poor judgment is penalized.

It must be admitted that construction cannot be avoided entirely in high-cost periods. Increasing business may demand new facilities. Some replacement will have to be made regardless of cost. Major expansion may be necessary in order to take advantage of business opportunities that will not be available again. However, where such construction is necessary to maintain or extend existing service, it can be kept at a minimum consistent with adequate service; in most cases it will represent only a relatively small percentage of the total investment. During this high-cost period the return on all the investment, including the low-cost construction of prior periods, should build up more than enough reserve to offset a low return (in subsequent low price periods) on the small amount of high-cost construction necessary in the present high-cost period. In spite of these unavoidable exceptions there are undoubtedly great opportunities here for the exercise of a measure of discretion and judgment with respect to construction that should,

[11] Some control over extravagance in construction costs is secured by requiring that all additions and improvements be approved by the Commission, prior to and during construction, both as to desirability and cost. This requirement should cover the charges to operating companies made by "management" holding companies.

under the reproduction-cost basis, pay handsomely (or penalize severely) in subsequent periods.

It is evident, therefore, that under this reproduction-cost basis, public utility common stocks are highly specialized investments, designed for those who desire to speculate and at the same time to exercise a degree of control over major business decisions which affect the speculative possibilities of their investments.

Total capital cost.—It has been contended that the reproduction-cost basis of rate-base determination increases the total capital cost—the total return necessary to induce capital to come into the public utility industry. The factor of safety of preferred stock and bonds is probably slightly decreased (in dollars) by the choice of this basis. Certainly additional uncertainty is added to common stock (in dollars always, and also in terms of real income) if the common-stock equity is relatively small. If this greater degree of risk is actually paid for by the utility (and therefore ultimately by consumers), then the total capital cost is higher and the total return to investors is greater. But it has not been demonstrated statistically that the higher capital cost really exists. "Risk" is hard to evaluate when risk in dollars may mean relative certainty in real income. And there have been attempts to prove, from the standpoint of all investments, that in the long run a high degree of risk is not necessarily more highly compensated—that the *chance* of high profits will attract capital, even though the average return over a long period of time may be no higher. In other words, "society" may get risk-bearing service at no extra cost. If this be true, the total capital cost would not necessarily be greater under a reproduction-cost basis of rate-base determination than under an original-cost basis.

It may even be argued that the total capital cost is *less* under a reproduction-cost basis than under the original-cost system. Construction indexes show that more construction takes place in high-cost periods than in low-cost periods. Therefore, a return on original costs will be "weighted" with high-cost construction, while a return on reproduction costs will have no such bias. The total cost of capital should, therefore, be less under a reproduction-cost basis.

CHAPTER III

THE CONSUMER POINT OF VIEW

The consumer has an interest in rate-base determination at least equal to that of the investor, for the basis selected influences substantially the rates charged for utility service. It is immediately evident that the use of the original-cost basis will result in more stable service rates in terms of dollars. Under this basis, fluctuating price levels will be reflected in utility rates only to the degree necessitated by changes in direct operating expenses such as salaries, maintenance, and other expenses that are payable currently. Return on investment (and depreciation of properties) will enter into the rate scale at levels based on original cost; the changed price levels will affect these items only through new construction actually taking place at the new cost levels.

"*Stability*" *of utility service rates.*—The question may be raised as to the desirability of forcing this "stability" of utility rates—holding them up in a period of declining prices and holding them down in a period of rising prices, by relating them to the original cost of capital assets used. Other prices—those of competitive products and services—tend to move with the reproduction cost of the capital assets consumed in their production. Thus to force utility rates "out of line" results in a fluctuating comparative advantage of utility services and alternative products or services. For example, in a period of declining prices, under an original-cost basis, industrial users of electric power may temporarily produce their own current as other costs decline more rapidly than electric power rates; it is possible also that in a period of rising prices users of steam power who customarily produce their own current will temporarily purchase electric power as other costs increase faster than that of electric power. Both of these changes may be uneconomic in the sense that only by artificial temporary malalignment of prices were they made to appear desirable; possibly neither type of change should have been made and both may have to be reversed later to secure the most economic sources of power. And a change of this kind is likely to be very costly because of the necessity of changing capital equipment.

The importance of this whole argument depends, of course, upon the extend to which there are real substitutes for utility services. In an-

other connection, but pertinent to this discussion, Horace M. Gray[1] points out that 97 per cent of consumers of electrical service paying 63 per cent of the sales revenue (in 1927) could not supply their own current nor would they accept any available substitutes. To a greater or less extent this same situation is true of other public utilities, but it is believed that this degree of possible substitution is sufficient to warrant attention to the point of view presented above.

The rate payer can best make his selections from alternative products and services—and plan for their use on a long term basis—if he is assured of a degree of stability in their costs—not stability in dollars, but stability in relation to the costs of alternative products and services. Any other condition makes the relative place of utility service uncertain; too rapid expansion may occur in high-cost periods, resulting in large amounts of idle utility capacity in subsequent low-cost periods.

In other words, stability of rates in dollars, under an original-cost basis, may be less desirable than stability of rates in terms of purchasing power under a reproduction-cost basis. The comparative advantages of alternative products and services is best maintained by the latter type of stability. Incidentally, in times of depression it is the "stickiness," the inflexibility, of *part* of the costs of business operation that is one of the chief deterrents to general business recovery. In spite of the relative inelasticity of demand for public-utility service, particularly for domestic use, it is probable that a more rapid adjustment of service rates, corresponding to the changes in other prices, would eliminate a part of the fluctuation in the volume of service demanded. A "complete" adjustment of rates ("complete" in that it corresponds to changes in other prices) is secured only by the use of reproduction costs.

Relative significance of alternative-cost-bases.[2]—The importance to the consumer of the choice of alternative bases of rate-base determination should not be exaggerated. In the first place, the "fair return" on the rate base represents 25 to 35 per cent of the total cost of the service for which he is charged.[3] In the second place, most utility properties are a

[1] *Journal of Land and Public Utility Economics*, V, 242–48.

[2] See also John Bauer, *Journal of Political Economy*, XXXIV, 495.

[3] It has been stated by good authorities that the return on the rate base represents only about 25 per cent of the total service cost. However, an analysis of the operating costs of several hundred operating companies shows that a return of 7 per cent on their rate base would represent about 35 per cent of their total operating cost. Depreciation at 3 per cent would add another 15 per cent. Therefore, should

composite of construction at various periods of time, representing, therefore, a weighted average of the prices that have existed in high- and low-cost periods. To adjust all of these to reproduction costs will rarely change the total rate base as much as 20 to 40 per cent. It is evident, therefore, that the change in the actual service rates, due to the choice of one basis or the other, would not exceed 5 to 20 per cent. However, when a major portion of the total plant has been constructed at extremely high-cost levels, or at very low-cost levels, the selection of the basis of rate-base determination will have much greater relative importance to the consumer.

Total costs and total return versus rate of return.—It is conceivable that under a reproduction-cost basis the consumer will pay no more in total than under an original-cost basis and that at the same time the investor will receive a higher rate of return. The actual amount paid under an original-cost basis will depend on the period of construction, but on the average the properties in use at any one time will have been constructed at various cost levels; and, over a long period of time, either a reproduction-cost basis or an actual-cost basis will approximate a weighted average of actual-cost levels. The advantage of a reproduction-cost basis lies in the "timing" of these costs, reflecting in the costs of each period the present-cost levels, and charging to the consumer, therefore, a more nearly competitive rate. Under an original-cost basis, since there is small incentive to construction in low-cost periods, the total construction, of a large company particularly, will probably be distributed somewhat uniformly among various cost levels.[4] If such be the case, the total return over a long period of time should be about the same as under reproduction cost—in so far as "averages" operate. The investor, on the other hand, may get a higher *rate* of return under reproduction costs, for under that basis there is an incentive to construction in low-cost periods. If such be the case, the result is a saving in actual construction cost—a smaller original total investment—but with no effect on total return to investor and therefore an increase in his rate of return—but with no increase in the total cost of the consumer.

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alternative bases for the depreciation charge be considered in connection with the choice of bases for rate-base determination, the total of the depreciation charge and the rate of return, both dependent on the basis selected, would represent about 50 per cent of the total service cost.

[4] It is probable that under an original-cost basis there will be a larger proportion of construction in high-cost periods to meet temporary demands created in these periods by "artificially" low rates, operating to the detriment of the consumer.

CHAPTER IV

REPRODUCTION COSTS BASED ON INDEX NUMBERS

Defects of reproduction-cost methods.—On preceding pages it has been suggested that the reproduction-cost basis of rate-base determination, as ordinarily applied, is expensive and inexact and that it very often involves delays, disagreements, and litigation. This statement can be supported by reference to numerous cases which have been before federal and state courts, and commissions.[1]

The seriousness of this situation is well stated by Mosher and Crawford,[2] as follows:

> The determination of the cost of reproducing a given property for the purpose of fixing a rate base has come to be one of the most involved and expensive tasks in the utility business. It requires a battery of engineers and accountants working months at a time and coming to conclusions with which no other like group working independently would agree. . . . .
>
> Furthermore, the costliness of property surveys as well as of extensive hearings both before commissions and courts, has resulted in the tendency to avoid the determination of a rate base and to resort to negotiations between commissions and utility companies. . . . .
>
> The adoption of this policy is equivalent to raising the white flag of surrender in this important phase of regulation, for in such negotiations the companies hold most of the trump cards.

This excess cost must be borne by the utility company (and to a great extent by the consumer), or by the public (the taxpayer). The tendency of recent legislation is to shift the burden to the company.

Most of this cost, and most of the uncertainties inherent in appraisals and other estimates, can be avoided by the use of index numbers, preferably a special index of public-utility construction costs. Table I illustrates such indexes and reflects their relation to an index of the general price level.

[1] The following cases are outstanding examples: The New York Gas Rate Cases, extended over a period of 22 years (1905–26); the evidence, abbreviated, fills 45 huge volumes. The New York Telephone Company Case lasted for 11 years (1920–30) and cost the company over $5,000,000. The Ohio Bell Telephone Company Case lasted 10 years (1922–31). For a more complete analysis of this problem see F. K. Beutel, "Due Process in Valuation of Local Utilities," *Minn. Law Review*, XIII, 430.

[2] *Public Utility Regulation*, pp. 191–93.

TABLE I

Comparative Indexes of General Prices and Public Utility Construction Costs

Year	(1) Federal Reserve Bank of N.Y. Index of General Prices*	(2) Public Utility Construction Costs†	(3) Electric Light Plant Construction Costs‡	(4) Telephone Company Construction Costs‡	(5) Public Utility Construction Costs Related to General Prices§		(6) Electric Light Plant Construction Costs Related to General Prices§		(7) Telephone Company Construction Costs Related to General Prices§	
					Absolute	Percentage	Absolute	Percentage	Absolute	Percentage
1913	100	100	100	100	0	0%	0	0%	0	0%
1914	100	98	96	96	— 2	2	— 4	4	— 4	4
1915	103	101	100	101	— 2	2	— 3	3	— 2	2
1916	117	121	124	114	4	3	7	6	— 3	3
1917	139	154	161	135	15	11	22	16	— 4	3
1918	157	175	177	149	18	11	20	13	— 8	5
1919	173	191	187	166	18	10	14	8	— 7	4
1920	193	227	207	192	34	18	14	7	— 1	1
1921	163	202	194	184	39	24	31	19	21	13
1922	158	180	174	171	22	14	16	10	13	8
1923	165	183	174	177	18	11	9	5	12	7
1924	166	181	173	170	15	9	7	4	14	8
1925	170	179	174	167	9	5	4	2	— 3	2
1926	171	178	174	.....	7	4	3	2	.....	.....
1927	171	175	172	.....	4	2	1	1	.....	.....
1928	176	176	174	.....	0	0	— 2	1	.....	.....
1929	179	179	180	.....	0	0	1	1	.....	.....
1930	168	172	171	.....	4	2	3	2	.....	.....
1931	150	162	159	.....	12	8	9	6	.....	.....
1932	132	148	144	.....	16	12	12	9	.....	.....
	Average differential.....				8%		6.3%		5%	

* The Federal Reserve Bank of New York Index of General Prices was selected as the most appropriate "purchasing power" index for the purpose in hand. In its preparation relative weights are assigned as follows:

Commodity prices at wholesale	2.0
Composite of wage payments	3.5
Elements of cost of living	3.5
Rents	1.0
Total	10.0

This index represents, probably better than any other index, a composite of the expenditures (costs, expenses) of the investor group which includes individuals of varying spending power as well as business and industrial enterprises of all kinds.

[Footnotes to Table I continued on next page]

Purchasing power versus competitive price.—It is not possible at all points in this discussion to distinguish clearly between "stabilized real income" and "competitive service rates" as related to the choice of a basis for rate-base determination. When speaking from the point of view of the investor, emphasis is laid on the purchasing power of his return, his "real income," presumably based on some general price index. From the point of view of the consumer, however, the important

† The public-utility construction-cost index is divided first according to types of utilities, and includes the following:

1. Waterworks plants	25 systems	68 items
2. Electric light plants	25 plants	84 items
3. Street railways	10 systems	82 items
4. Natural gas plants	15 systems	58 items
5. Artificial gas plants	25 plants	63 items

A further subdivision is made among main groups of items, as follows:

1. Land
2. Buildings
3. Equipment } For street-railway systems these two items are replaced by three others—track construction, span construction, and cars and equipment.
4. Distribution }
5. Miscellaneous

Since 1925 this index has been prepared by C. F. Lambert, of the Burns and McDonnell Engineering Company, Kansas City, Missouri. For the first four years it was published in the *Engineering News Record;* since 1931 it has appeared in *Construction Costs* published annually by *Engineering News Record*, where it is more fully described.

Mr. Lambert further describes his manner of procedure as follows:

"These figures were worked up in the following manner for the electric light systems and the same method was used in all of them.

"I took appraisals of 25 electric light systems and divided the value into 84 separate items. For instance, the building was divided into brick, cement, structural steel, reinforcing steel, roofing, windows, and all other various items of material which went into the building as well as the various classes of labor. The equipment was divided into turbines, condensors, boilers, heaters, piping, switchboards and other various items going to make up this part of the construction. Then the miscellaneous items were divided into conveyance equipment, furniture and fixtures, tools, etc. I found the proportionate part which each of these items played in the construction of an electric light plant in this average of twenty-five plants. Since the original set-up, I have added other plants to the list so that as the trend in equipment changed, this was reflected in the final set-up. Taking each of these items then in the proportion in which it is used to make up the complete plant, I have each year applied the prices of that year for each item to that proportionate part, thus obtaining what I believe is a very accurate record of the trend of construction costs. For labor, I have taken the labor prices in 8 representative cities scattered throughout the United States, not using cities like New York or Chicago in which the labor prices might be out of line from the general situation in the country. For the other prices, I have used Government figures and actual quotations and bids which we have received in determining the relative values."

It is not insisted that this particular public-utility construction-cost index is the best possible index for the purpose in hand, but it demonstrates the possibility of constructing specialized public-utility indexes; it is probably at least fairly satisfactory for the purpose, as indicated by the description of the methods followed in its preparation.

Because the value of land has been held constant in this index as published, an adjustment has been made to remove the effect of this item. In order to arrive at an "average" index for the major types of utilities, weights were assigned to the adjusted figures corresponding to the relative property values each year for each type of utility. Data relating to property values were secured largely from Moody's *Investment Manuals*, and from the 1932 statistical abstract of Bureau of Census figures, with some reliance on estimates made by Nash, Prendergast, and other reputable authors in the public-utility field.

‡ In columns (3) and (4) are presented two still more highly specialized indexes. The first, for electric light plants only, is one of the four indexes combined in column (2); in that average it has a weight of about 60 per cent in 1932, but only about 25 per cent in 1913. The figures in column (4), for the telephone companies only, are presented by Paul Jerome Raver in his very excellent article "Index Numbers of Public Utility Construction Costs" in the *Journal of Land and Public Utility Economics*, III, pp. 343–60.

§ Columns (5), (6), and (7) present relationships between the general price index and each of the public-utility construction-cost indexes, in absolute figures and in percentages. The figures apply only to property acquired in 1913.

factor is the "relative" price of utility and alternative services, a "competitive" price, which will vary with utility construction costs. That these two conditions do not result automatically and perfectly from the use of a single rate base has been clearly pointed out by Bonbright and others.[3] In the first place, utility construction costs and general prices are not always at the same average levels. The extent to which the relative fluctuations in these two groups of prices vary from period to period is indicated by Tables I and II. A study of these indexes brings out the fact that the dissimilarity of the fluctuations is not so serious as might at first appear.

Analysis of Table I.—An inspection of the tabular comparison of index figures in Table I reveals these pertinent facts relating to the period 1919–32:

1. The general price-level index presented has followed the same general trend as the public-utility construction cost indexes.
2. Only in times of rapid price change has there been any material difference between the fluctuation of public-utility construction costs and the movements of general prices, as for example, the period 1914–23.
3. Even in this period of the most rapid price change the maximum differential between the general public-utility construction-cost index and the general price-level index was only 24 per cent (20 per cent if based on the higher of the two figures compared). The average differential is only 8 per cent (adding both plus and minus differences).
4. The index for construction costs of electric light plants has followed still more closely the general price-level index; the maximum variation is also 24 per cent, but the average for the 20-year period is only 6.3 per cent.[4]

It is evident that in the actual application of index numbers to original costs to arrive at a measure of reproduction costs, the more narrowly specialized the index the more accurate will be the method from the

[3] J. C. Bonbright, *Harvard Law Review*, XLI, 593; Mosher and Crawford, *op. cit.*, pp. 212–14.

[4] The index for construction costs of telephone companies shows an even greater correlation with general prices—the maximum differential being 13 per cent and the average only 5 per cent (to 1925).

Other specialized indexes (not shown here) presented by Mr. Raver in the article referred to above, and by L. R. Nash in *Economics of Public Utilities*, p. 183, show greater deviation from general prices.

point of view of the consumer (though larger discrepancies may result between the highly specialized index and that for the general price level).

The comments appended to Table I point rather definitely to the following conclusions with reference to property acquired in 1913: That on the average there was about 8 per cent disparity in the fluctuations of public-utility construction costs and general prices; that the maximum differential in any one year from 1913 to 1922 was 24 per cent; that the general trend of the indexes is very similar.

Property acquired subsequent to 1913.—During the particular twenty-year period studied, 1913–32, practically all discrepancies between the general price index and utility construction-cost indexes have apparently tended to increase the real income of the investor group. This would be true only for property purchased in 1913. In the long run, of course, any "gains" to investors on this score will, on the average, be offset by "losses" when the differential between the two types of indexes is to their disadvantage. Furthermore, the apparent differential is greater than any probable actual differential; at any given time the properties actually in use by a public-utility company will have been constructed at varying cost levels, and their actual cost will, therefore, correspond to a composite of the index figures of preceding years. Table II presents in tabular form the "gain" or "loss" in investors' real income which would have resulted in each year, from 1913 to 1932, from the use of index numbers in determining the reproduction cost of property acquired in any preceding year—back as far as 1913.[5]

Analysis of Table II.—The figures in Tables I and II were computed by the use of the following formula:

$$\frac{\frac{PU_2}{PU_1}}{\frac{GP_2}{GP_1}} - 100 \text{ per cent} = \text{per cent of "gain" (+) or "loss" (−) in investors' real income.}$$

Where PU_1 = public-utility construction-cost index number of year of acquisition

PU_2 = same index number for "date of the inquiry"

GP_1 = general price index number of year of acquisition

GP_2 = same index number for "date of the inquiry."

[5] The effect of the inevitable "lag" in the actual application of index numbers is illustrated on pp. 61–62 ff.

TABLE II

PER CENT OF "GAIN" (+) OR "LOSS" (−) OF INVESTOR REAL INCOME DUE TO USE OF REPRODUCTION-COST BASIS

DATE OF INQUIRY	YEAR IN WHICH ASSETS ARE ACQUIRED																				ARITHMETIC TOTAL	ALGEBRAIC TOTAL	ARITHMETIC AVERAGE	ALGEBRAIC AVERAGE	DATE OF INQUIRY
	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932					
1913	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0	0	.....	1913
1914	− 2	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	− 2	2	− 2	1914
1915	− 2	0	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2	− 2	1	− 1	1915
1916	3	5	5	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	13	13	4	4	1916
1917	11	13	13	7	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	44	44	11	11	1917
1918	11	14	14	8	1	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	48	48	10	10	1918
1919	10	13	13	7	0	− 1	0	....	....	....	....	....	....	....	....	....	....	....	....	....	44	42	7	7	1919
1920	18	20	20	14	6	6	6	0	....	....	....	....	....	....	....	....	....	....	....	....	90	90	13	13	1920
1921	24	26	27	20	12	11	13	6	0	....	....	....	....	....	....	....	....	....	....	....	139	139	17	17	1921
1922	14	16	16	10	3	2	3	− 4	− 8	0	....	....	....	....	....	....	....	....	....	....	76	52	8	6	1922
1923	11	13	13	7	0	0	1	− 5	−10	− 2	0	....	....	....	....	....	....	....	....	....	62	28	6	3	1923
1924	9	11	11	6	− 1	− 3	− 1	− 7	−12	− 4	− 2	0	....	....	....	....	....	....	....	....	67	7	6	1	1924
1925	5	8	7	2	− 5	− 6	− 4	−10	−14	− 8	− 5	− 3	0	....	....	....	....	....	....	....	77	− 33	6	− 3	1925
1926	4	6	6	1	− 6	− 6	− 6	−12	−16	− 8	− 7	− 5	−2	0	....	....	....	....	....	....	85	− 51	7	− 4	1926
1927	2	5	4	− 1	− 7	− 8	− 7	−13	−17	−10	− 8	−6	−3	−2	0	....	....	....	....	....	93	− 71	7	− 5	1927
1928	0	2	2	− 3	−10	−10	−10	−14	−19	−12	−10	−8	−6	−4	−2	0	....	....	....	....	112	−104	8	− 7	1928
1929	0	2	2	− 3	−10	−11	− 9	−15	−19	−12	− 9	−8	−5	−4	−3	0	0	....	....	....	112	−104	7	− 7	1929
1930	2	5	4	− 1	− 7	− 8	− 7	−13	−17	− 9	− 8	−6	−3	−1	0	3	2	0	....	....	96	− 64	6	− 4	1930
1931	8	10	10	5	− 3	− 3	− 2	− 9	−13	− 5	− 2	0	3	3	6	8	8	6	0	....	104	30	6	2	1931
1932	12	14	15	8	1	1	1	− 4	−10	− 2	1	3	6	8	10	12	12	9	3	0	132	100	7	5	1932
Total (+)	144	183	182	95	23	20	24	6	0	0	1	3	9	11	16	23	22	15	3	0	Total 1,398	162	139	.....	.....
Total (−)	4	0	0	8	49	56	46	106	155	72	51	36	19	11	5	0	0	0	0	0	Average 7%	0.9%	7%	.....	.....
Net (+)	140	183	182	87	....	....	....	....	....	....	....	....	....	0	11	23	22	15	3	0					
Net (−)	....	....	....	....	26	36	22	100	155	72	50	33	10	0	....	....	....	....	....	....					

An inspection of this table reveals the following facts. The maximum deviation of public-utility construction costs from general prices was 27 per cent—the reproduction cost in 1921 of property acquired in 1915 being 27 per cent higher, relative to the 1915 level, than general prices, a 27 per cent "gain" to the investor. In 1921 also occurred the highest average (simple arithmetic average) differential for property purchased in all preceding years back to 1913, the average in that year being a 17 per cent "gain" to the investor. While data are not available on the relation of the two indexes in years prior to 1913, it is probable that in most actual cases arising in 1921 the average investor "gain" or "loss" would have been considerably less, for the inclusion of property acquired prior to 1913 would undoubtedly have reduced the relative weight of the years 1920 and 1921, the high "investor-'gain'-years."

The simple arithmetic average of the "loss" or "gain" or investors' real income in each year back to 1913, is 7.8 per cent; but the algebraic average is less than 1 per cent net "gain" to investors.

Conclusions with respect to index numbers.—The general conclusion, therefore, is that the application of public-utility construction-cost index numbers to the original costs incurred, in order to arrive at an approximate reproduction cost, will achieve rather satisfactorily the following results: (1) For the consumer a fairly approximate "competitive" rate which fluctuates in general conformity with prices of alternative services; (2) For the investor group a *total* return that tends toward a constant real income, subject to average discrepancies of perhaps 8 per cent or less and to occasional discrepancies of perhaps 25 per cent.

It would appear to be somewhat illogical to argue for an actual-cost basis of rate-base determination because reproduction costs fail by as much as 25 per cent to secure for the investor a constant real income when under original costs the purchasing power of the investors' income may fluctuate by as much as 100 per cent, or more. If a reproduction-cost basis secures an approximate "competitive" rate for the consumer, and approximates so closely a constant real income for investor, the comparatively minor disparity in investors' real income should not condemn the whole basis.

Objections to the use of index numbers.—Further objections to the use of index numbers are usually based on one of two contentions: (1) that the amount determined represents the reproduction cost of the identi-

cal plant, perhaps obsolete, which would not be reproduced under modern conditions, rather than a modern plant; or (2) that no effect is given to improved methods and reduced costs of constructing the identical plant.

It must be admitted that the adequacy of this method of determining reproduction costs tends to vary inversely with the length of time between the acquisition of the property and the "date of the inquiry." The ideal application, perhaps, is one in which there has been a prior "valuation" or appraisal within five or ten years. In such a case these figures can be brought up to date by the use of index numbers, and subsequent additions can be adjusted to current reproduction costs with relatively little difficulty.[6]

To answer more directly the objections set forth above it may be repeated that the same objections apply to the original-cost method. Any allowances made for depreciation and obsolescence, or for changes in methods of construction, under original costs, can be made with equal accuracy under reproduction costs based on index numbers. Only a reproduction cost-of-the-service basis completely avoids this objection, and, as previously stated, this method is impossible of application for practical reasons, though perhaps ideal from the competitive standpoint. It is maintained that the most *practicable* basis for an approximate competitive price situation is that of reproduction costs, and that the least expensive, most efficient method of computing reproduction costs for this purpose is that of adjusting original costs by a special index of public-utility construction costs. Therefore, the chief discrepancy between stabilized real income to investors[7] and competitive price to

[6] In *Re Chesapeake & P. Telephone Co.* (Md.), 1 P.U.R. (N.S.) 346, index numbers were applied in just this fashion to adjust to current reproduction costs the results of a prior appraisal and subsequent additions. It was stated by the Commission in this case that in all similar cases index numbers had produced results which varied less widely than did the testimony of expert witnesses on opposite sides.

[7] On other pages it has been pointed out that the "stabilized real income" to investors is in terms of *totals* only. The distribution of this income among types of investors, some of whom hold fixed (dollar) income bearing securities, may result actually in a decreased real income to one group and an increased real income to another group. This cannot be avoided except by financing public utilities through the issue of a single class of common stock, or by "adjusting" to a purchasing power parity the "fixed" return of bondholders and preferred stockholders. See n. 9 on page 14.

consumers (as defined above) lies in the dissimilarity of fluctuations of the indexes described above. The significance of this dissimilarity has already been discussed.

Furthermore, it may be argued from the standpoint of "justice and equity" to the common stockholder that he *should* "benefit" or "suffer" as the reproduction costs of capital assets vary from original costs. If the consumer is entitled to a "competitive" rate and if there is an inevitable risk created by the construction of capital assets to furnish service at this competitive rate, surely the common stockholder should bear this risk, in regulated as well as in competitive business. It may be repeated that this is a risk in a real sense, only when (*a*) public-utility construction costs get "out of line" with general prices, (*b*) part of the capital is secured on a fixed (dollar) return basis, or (*c*) a fair rate of return requires service rates higher than "the traffic will bear."

CHAPTER V

DEPRECIATION ACCOUNTING

Nature of Depreciation.—Depreciation has been variously described or defined as follows: "the decline in value-in-use of fixed tangible assets"; "expired capital outlay"; "an allocation of the entire cost of depreciable assets to the operating expenses of a series of fiscal periods." For the railroads the Interstate Commerce Commission defines depreciation as "the loss in service value, not restored by current maintenance . . . . whose effect can be forecast with a reasonable approach to accuracy."[1] For public utilities this term is described as "the loss in total intrinsic service value of a unit or item of structural property in its existing position and relationship as part of a utility plant."[2]

The statements above indicate that the term "depreciation" may be used to refer to the process of value expiration, to the amount of the periodic charge to operating expense, or to the total amount of the decline in value as of a given date—the "accrued" depreciation. It is obvious that for public utilities the amount of the periodic charge is an important item in determining the total expenses of operation, while the amount of the accrued depreciation is an equally important factor in determining the rate base on which the company will be permitted to earn a fair return.

Physical and functional depreciation.—For some purposes the term "depreciation" has been restricted to the loss in value due to wear and tear and other physical forces. A broader conception, however, includes also any losses in value-in-use arising from other causes, including principally obsolescence and inadequacy.[3]

[1] In its Order No. 15,100, July 28, 1931.

[2] D. F. Wilcox, *Depreciation in Public Utilities*, p. 1.

[3] Prendergast, *Public Utilities and the People*, p. 154, defines these terms as follows: "*Obsolescence* may be defined as the going out of use, represented by a diminution in value of the property arising from causes outside the property itself. This condition is usually brought about by new inventions, progress in the art, results of research or discovery which render plant, equipment, or device unsuitable or expensive to operate as compared with apparatus of more modern design and greater efficiency of use." "*Inadequacy* occurs when property becomes of insufficient capacity

For public utilities the latter are frequently important causes of great value losses. One authority in the public-utility field states that "the preponderance of retirements is due to functional or non-physical causes."[4] It would seem, therefore, that they cannot be excluded from consideration unless it be demonstrated that losses arising therefrom cannot be "forecast with a reasonable approach to accuracy." For most accounting purposes it is becoming more common practice to recognize as a current expense of operation both "physical" and "functional" depreciation.

The Reserve for obsolescence and inadequacy.—It is generally recognized that obsolescence and inadequacy are more difficult of prediction than is physical depreciation.[5] This fact has caused some authorities to advocate that no attempt be made to absorb into current operating costs any potential losses that may arise from these causes. It is admitted that any attempt to predict accurately the losses to be caused by the future obsolescence or inadequacy of single specific property items is doomed to failure. On the other hand, in most cases it is possible to predict "with a reasonable approach to accuracy" the total losses that will occur from this source on all fixed properties. This makes possible the creation of a single general "reserve for obsolescence," by charges into current operating expense; against this general reserve may be charged all losses caused by the retirement of fixed properties before they are completely written off into expense by the usual depreciation charge. In all probability 100 per cent accuracy will not be secured, but even if errors do occur, the estimates should be within a reasonable margin of error and the result will therefore be more accurate than that secured by completely disregarding these factors.

"*Property Abandoned.*"—The treatment of obsolescence and inade-

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to meet demands. Frequently, in spite of the fact that a unit of property is in good operating condition, unexpected growth of the community of increased customer-demand may render such unit unsuitable to meet requirements."

[4] L. R. Nash, address before the International Congress of Accountants in 1929.

[5] "Changes in the arts, due to the versatility of the human mind in the face of need, municipal requirements maturing as the political and civic exigencies of the community mature, the overmastering influence of economic revolutions, the shifting tides of population and industry—all these lie concealed behind the drawn curtains of the future, and with them are hidden the ways and times of obsolescence" (Wilcox, *op. cit.* p. 7).

quacy described above would seem to be much more logical than the procedure usually followed, that of charging the undepreciated balance of fixed assets retired to "property abandoned," a suspense account to be distributed over future periods as an operating expense. It is hard to see just how consumers in future periods can benefit from past errors in depreciation allowances; certainly they may benefit from the use of the new and improved equipment, but this can be fully covered by adequate depreciation charges on the *new* equipment (unless error is repeated). The new equipment is no more productive because of the unabsorbed capital cost of the obsolete property which it replaces. The only justification for the use of the property abandoned account probably lies in the fact that retirement losses are not always provided for by prior depreciation charges and must, therefore, either be charged to surplus at the time of retirement or carried forward to future periods. If the latter should be prohibited a good many improvements would not be made, modern equipment would not be introduced, and the high operating costs and low efficiency of the obsolete and inadequate equipment would result in higher service unit costs to the consumer than would the use of a newer equipment, even when loaded with the amortization of "property abandoned."

Depreciation Accounting versus Retirement Accounting.—It is a generally recognized principle that the rates charged for public-utility services should cover not only the current expenses of operation and a fair return on capital invested but also the consumption of capital assets "used and useful" in rendering the service. There is not universal agreement, however, as to the basis on which this last cost should be apportioned among the fiscal periods in which the expiration of capital asset value occurs.

In general, there are four alternatives: (1) the cost of these assets may be charged as expenses in the period in which they are acquired; (2) their costs may be charged to the period in which they are retired—"retirement accounting"; (3) the original cost of the assets may be allowed to remain on the books and the costs of replacements may be charged against the period in which the replacement takes place—"renewal expense accounting"; (4) the cost of the assets may be apportioned, on one of several bases, among all of the periods in which they make a contribution to the production of the service and in which the resultant decline in their value-in-use occurs—"depreciation account-

ing." It is evident that all of these methods, over a long period of time, tend to result in the same *total* charge to all consumers and ultimately to return to investors their original investment intact; any choice among them must, therefore, depend upon the relative accuracy of the various methods in the distribution of the costs among the fiscal periods involved—the distribution of the charges to *successive* consumers and of the return to *successive* investors.

It is apparent immediately that only under certain very specific conditions would any of the first three methods result in an equitable distribution of charges among the fiscal periods involved. If assets are completely consumed in the period in which they are acquired, or if acquisitions and retirements of assets are uniformly distributed among accounting periods, the results of any one of these three methods might be satisfactory. But under most actual situations, where durable capital assets are "consumed" over several periods and where acquisitions and retirements are not uniform in amount from period to period, these methods operate to distribute costs inequitably.

The charging of capital assets to the period of acquisition loads too heavily the early periods of operation and results either in operating losses or in excessive charges to consumers during those periods. This method has never been advocated as being applicable to public-utility accounting; only expenditures of small amounts, classified in the accounting system as "repairs," are handled by this method.

The practice of charging capital assets against the period in which they are retired—"retirement accounting"—has considerable recognition in the public-utility field, particularly in gas and electric utilities.[6] It has been justified on the grounds that for certain types of assets the "law of averages" does operate—that retirements do tend to be distributed uniformly among accounting periods. Unfortunately, the facts of the case do not support this general assumption. In only a very few cases would the nature of the assets warrant the assumption that retirements would be uniform from period to period, the best example, perhaps, being the ties and rails of a large railway system. Even in this case any variation of policy with respect to right-of-way maintenance, or any expansion or contraction of track mileage, would unbalance the operation of the "law of averages." In any case,

[6] However, New York State has just recently put gas and electric utilities on a straight-line depreciation accounting basis.

the early years of operation when properties are new are "undercharged" and the final years when properties are retired are "overcharged"; this statement applies to each asset item individually, certainly, and only in intermediate years of uniform maintenance policy when there is no expansion or contraction of track mileage do the "undercharges" and "overcharges," with respect to single asset items, offset one another and result in equitable charges to consumers for expiration of capital asset values.

Renewal expense accounting differs from retirement accounting in that prices at the time of retirement (and replacement) rather than the original costs at the time of acquisition are charged into expenses of operation. Under normal periods of comparatively stable prices there is little to choose between the two methods, except that plant records are much more accurate on a retirement accounting basis. But in periods of major price change the results may be vastly different. Renewal expense accounting is based on the theory that the original investment in assets should be maintained intact in terms of physical quantities, or purchasing power, while retirement accounting tends to maintain intact the investment in dollars. It is obvious that under either of these methods, if the replacement varies from the original asset in size, quantity, or quality, proper adjustment must be made to the property account. Changes in prices only, not in the physical qualities of the asset, distinguish one method from the other.

Retirement reserves.—Because it is recognized that even in a large company retirements will vary from period to period, "retirement reserves" are frequently created and actual retirements are charged against this reserve, either at original cost or at the cost of replacement. These reserves may be set up out of "amounts appropriated from surplus plus amounts charged to retirement expense—upon a basis determined to be equitable according to the accounting company's experience and best sources of information."[7]

Such reserves provide only for predicted actual retirements and should not be confused with "depreciation reserves," which represent an estimate of the total expired value of the assets. Retirement reserves are usually only about 1 per cent to 10 per cent of original property costs, even for established companies which have been in operation

[7] *Uniform Classification of Accounts for Gas Utilities*, published by National Association of Railway and Utilities Commissioners, 1931.

long enough for their properties to have reached an average of about 50 per cent of their total life-expectancy. For such a long-established company, in so far as these reserves constitute adequate provision for future retirements and are being maintained by fairly uniform charges to operating expenses, the method is satisfactory for determining profits (and for financing replacements if the charges are at replacement cost). The fact remains, however, that early periods of operation have been undercharged, for a large amount of capital asset value has "expired" which has never been charged into the costs of operation. It follows, of course, that asset values are overstated.[8]

"Overcharges" under retirement accounting.—In all arguments in favor of the retirement method of accounting, and the consequent inclusion of the assets in the rate base at the amount of their cost (original or reproduction) there is the statement, express or implied, that while prior consumers may have paid *less* than a fair rate for service, present consumers are paying an equitable charge; it is further contended that future consumers will not be overcharged, because the plant as a whole will never be raised to a substantially higher percentage of condition than that now obtaining, for 100 per cent replacement new will never occur all at one time; therefore for all time to come present and future consumers need to pay only for such repairs and renewals as will keep the plant in its present "normal condition" and which represent, therefore, a fair and equitable charge.

Granting, for the moment, the possibility of securing uniform charges for current renewals and replacements, and granting the "normal condition" concept, a careful analysis of this argument reveals the following fallacy: If charges for depreciation had been made in early periods of operation the net investment in the property would have

[8] The present position of the railroads under Order No. 15,100 of the Interstate Commerce Commission well illustrates this point. Retirement accounting has long been the policy with respect to track equipment. Now that the Commission requires "depreciation accounting" the railroads are faced with the possibility of being forced to write off against surplus "expired value" of ties and rails which has never been charged to operating expense. In normal periods this would amount to about 50 per cent of original cost. Under present conditions of deferred maintenance it is probable that between 55 per cent and 65 per cent of the service value of such equipment no longer exists, although no corresponding charge has been made to operations. This problem is discussed by George O. May in the *Quarterly Journal of Economics*, XLIII, 193 ff., and XLIV, 687 ff.

been reduced, that is, the excess of the depreciation charge over the actual costs of replacements and repairs would have served to reduce the amount of the rate base; therefore, even though an annual charge for depreciation would equal, on the average, the cost of current maintenance of renewals and replacements of a "normal condition" plant, under the retirement method of accounting there is a larger rate base on which the utility may earn a return; there is, therefore, a larger total of service cost than under depreciation accounting; and consequently all consumers after those of early periods are overcharged.

The only tenable basis for refutation of this statement is the assumption that the early periods of operation could not carry a full depreciation charge, that under "depreciation accounting" there would have been operating losses which would have been carried forward in the rate base as "going value," and that under "retirement accounting" the higher "value" of physical assets represents in reality a "cost of establishing the business."

A discussion of the merits of including the item "going value" in the rate base is not pertinent at this point. It may be stated, however, that a much more accurate picture of operating results and of financial condition would be presented if physical assets were shown at their depreciated or "book" values and going value were allowed to stand or fall on its own merits.[9]

[9] For a discussion of "going value" and its relation to the determination of the rate base the reader is referred to "Going Value in Rate Cases in the Supreme Court," by Edward W. Bemis, *Columbia Law Review*, XXVII (May, 1927), 530ff.

CHAPTER VI

ACCRUED DEPRECIATION

Periodic and accrued depreciation.—As previously noted, the subject of depreciation of public-utility properties for purposes of rate-making has a twofold aspect: (1) the annual charge into operating expense to cover the expiration of value-in-use of fixed properties, and (2) the amount of expired use value to be deducted in the determination of the rate base on which there may be earned a fair return. That these two aspects of the problem are closely related is obvious. That any fraction of fixed property costs (original or reproduction) which has been collected from the consumer in the form of depreciation charges should thereafter be deducted in determining the rate base seems perfectly logical and equitable; in some respects these charges are similar to amounts paid on outstanding debt, which must thereafter be deducted from the principal in computing interest.[1] That there have been many cases in which a public-utility company has collected from consumers in depreciation charges as much as 40 per cent of the original cost of the property, over and above all costs of maintenance, repairs, renewals, and replacements, and has thereafter maintained successfully in court that this same property was then in 90 per cent condition and should be included in the rate base at that percentage of cost (original or reproduction), seems unbelievable—until one reads actual cases on public-utility valuation. Commission and court decisions relating to public-utility regulation furnish ample evidence that there is not universal agreement that the depreciation charge and accrued depreciation are "Siamese twins" demanding simultaneous consideration in rate-making.[2]

[1] There is one exception to this general statement; if depreciation is computed by the sinking fund method, no deduction should be made from the rate base for accrued depreciation. See pp. 80–83 ff.

[2] Chairman Maltbie, of the New York Public Service Commission, in *Re Yonkers R. Co.*, P.U.R. 1933 B, 80, commented on this point as follows:

". . . . there are many advocates in rate cases who will contend that in determining accrued depreciation and the annual depreciation allowance, facts recognized in one instance should be ignored in the other and that the two things should be kept entirely separate. Indeed, companies often go so far as to produce separate witnesses, one to testify as to accrued depreciation, and another to testify as to annual depre ciation allowance."

On this point there is a diversity of viewpoints even among utility companies. In the hearings before the Interstate Commerce Commission on depreciation charges for steam railroad companies and telephone companies Colonel William J. Donovan, counsel to the New York Commission on Revision of the Public Service Commission Law, summarized this variety of views as follows:

> The interstate Commerce Commission favors depreciation accounting on a straight-line basis and the deduction of the amount of the depreciation reserves computed on the same basis as a measure of depreciation in valuation.
>
> The telephone companies favor depreciation accounting, but deny that the amount of the depreciation reserve has anything to do with valuation, contending that observed deterioration is the only measure of depreciation.
>
> Certain of the railroad, gas and electric companies favor retirement accounting, and contend that no depreciation should be deducted from the cost of reproduction of a plant for valuation purposes, if it is giving satisfactory service, or unless there is deferred maintenance affecting the quality of service . . . . certain railroad, gas and electric companies favor retirement accounting and the deduction from the cost of reproduction of observed depreciation for valuation purposes.[3]

The depreciation reserve.—Under accurate "depreciation accounting" methods a credit balance in a depreciation reserve indicates the amount of "incomplete depreciation"—the amount which has been charged into operating expense for expired asset value (and thereby "recovered" from the consumer) but which has not yet been absorbed by actual retirements and replacements. This amount should be equal to the expired value-in-use of all assets which have not yet been retired and which are still "used and useful" in producing the service; that is, it should bear the same ratio to cost (original or reproduction) as the expired service life bears to the total expected service life of the assets. If this is not the case, then too much depreciation or too little depreciation has been charged into the operating expenses of preceding periods.[4]

Inadequate depreciation in past periods.—If an amount representing less than the expired service life of the assets has been charged into expense, then consumers of prior periods have been undercharged for service rendered or investors have received more than a fair return.

[3] N.Y. Commission on Revision, *Report*, I, 129.

[4] A more detailed statement of reasons why the depreciation reserve may not be an accurate measure of accrued depreciation may be found in a bulletin prepared by

The result is the same whether the company has been consciously and voluntarily following a policy of "retirement accounting," has been prohibited by commission or court regulation from charging proper amounts for depreciation, or has erred in judgment as to probable total service life and has, therefore, set the depreciation rates at too low a figure. In any case, too large a proportion of the asset cost (original or reproduction) has been carried forward to present and future periods. (If too much depreciation was charged off in prior periods, the results are the reverse of the foregoing statements.)

Advocates of retirement accounting insist that there will never be any necessity for correction of these past undercharges, that the public-utility company is to all intents and purposes a perpetual enterprise, and that complete retirement and replacement new will never be necessary at one time; their conclusion is that for purposes of the rate base nothing need be deducted from cost new (original or reproduction) for expired asset values, except for "deferred maintenance" which impairs efficiency and requires immediate expenditures for repairs or replacements. But the fact of these undercharges to prior consumers (or excess earnings to investors) remains. A part of the original investment has been impaired; the fact that this impairment will never demand actual expenditure because the property will never be restored entirely new in a single period, hardly seems to justify its complete dismissal from consideration.

An engineer's attitude on this matter appears below.

It would seem . . . . that if we are seeking a "just amount" upon which to base returns, a property which is rendering good service cannot justly be

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the staff of the Public Service Commission of Wisconsin, *Depreciation*, pp. 63–64. They are here summarized briefly:

(1) Estimate of average service life and of net salvage may be inaccurate.

(2) Expenditures for repairs and maintenance may have been improperly charged against the depreciation reserve.

(3) Expenditures chargeable to the reserve may have been charged to expense.

(4) Accrued depreciation on properties retired may not have been deducted from the reserve.

(5) When depreciation accounting was first inaugurated, the balance in the reserve may not have reflected accurately the depreciation up to that time.

(6) Going plants may have been purchased and the reserves acquired therewith set up without proper adjustment.

(7) Entries made in the reserve in connection with appraisals may not reflect the exhaustion of service life.

depreciated unless it can be shown that the investors have been reimbursed for the depreciation by legally established depreciation charges or by illegal excess of profits in the past.[5]

However, in the Knoxville water case,[6] decided in 1909, three years before the date of the Allison report, the United States Supreme Court maintained a contrary opinion. There the court said:

If, however, a company fails to perform its plain duty and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon overissues of securities, or of omission to exact proper prices for the output, the fault is its own. When, therefore, a public regulation of its prices comes under question the true value of the property then employed for the purpose of earning a return cannot be enhanced by a consideration of the errors in management which have been committed in the past.[7]

Court and Commission decisions have not, however, been unanimous in the opinion expressed above. Most decisions support this view, but there are others supporting a contrary or a qualified opinion.[8] The conflicting views may be summarized fairly accurately as follows:

(1) Normally, accrued depreciation should be deducted in determining the rate base.

(2) Extreme and sudden obsolescence need not be deducted until amortized by charges against future periods.

(3) Inadequate past charges for depreciation do not justify an undepreciated rate base if due to excessive earnings or mismanagement; even if past returns have been inadequate accrued depreciation is deductible in determining the rate base (in most cases).

(4) Excessive reserves in the past need not always be deducted, but

[5] From a report entitled "Should Public Service Properties be Depreciated to Obtain Fair Value in Rate or Regulation Cases?" made by James E. Allison, Chief Engineer, to the St. Louis Public Service Commission, September 11, 1912.

[6] *Knoxville* v. *Knoxville Water Company*, 212 U.S. 1.

[7] Other U.S. Supreme Court cases supporting the opinion that past errors of management do not justify an undepreciated base are these: *Galveston Electric Company* v. *City of Galveston et al.*, 258 U.S. 388; *Georgia Railway and Power Company* v. *Railroad Commission of the State of Georgia*, 262 U.S. 625; *Board of Public Utility Commissions et al.* v. *New York Telephone Company*, 271 U.S. 23.

[8] Reference to the cases listed and to the opinions quoted on pp. 42–44 ff. will serve to indicate the wide variety of legal opinions on this subject.

the burden of proof is upon the company to prove that their deduction would result in confiscatory rates in the future.[9]

(5) During recent years there appears to have been a distinct tendency toward determining the amount of accrued depreciation by the balance in the depreciation reserves.[10]

(6) The amount of the accrued depreciation may be based on the age-life method of computation, upon other methods of computation, or may be determined by "observation"; there is little uniformity in the methods of determining the proper amount of accrued depreciation.

Against deduction of accrued depreciation.—A fairly plausible case against the deduction of accrued depreciation in the determination of the rate base is presented in the quotation below. There is some implication here that retirement accounting is a desirable complement to the basis of rate-base determination described, that of reproduction cost new less only such depreciation as impairs the actual operating efficiency of the assets.[11] However, many of the statements made and the arguments presented seem to be unrelated to any annual charge for depreciation. The fact that depreciation has or has not been actually accrued in the past (and fixed asset costs thereby recovered—or not—from consumers) seems not to be a point for consideration in the de-

[9] In conflict with the general opinion expressed here, the Wisconsin Commission recently deducted as accrued depreciation the total amount credited to the utility's depreciation reserve, even though the reserve accumulation was admittedly in excess of past depreciation requirements. The Commission stated:

". . . . We do not know how much of the excess in the depreciation reserve has resulted from excess depreciation allowances or incorrect accounting practices. However, to the extent that this excess has resulted from excessive and duplicate depreciation charges at the expense of the ratepayers, we believe the company is estopped from claiming that the residual of the amounts so collected should not be deducted from the property and plant account for rate-base purposes" (*Re Mondovi Teleph. Co.*, P.U.R., 1933 B., 325).

[10] The Oregon Commission in *Re Northwestern Electric Co.* (P.U.R., 1933 A., 493) has applied this rule in the reverse order. There the small amount of claimed accrued depreciation was used as a basis for allowing a smaller annual depreciation charge in subsequent periods.

[11] The argument as presented here for omission of accrued depreciation does not stand or fall with reproduction costs. On subsequent pages (pp. 52–62) there will be discussed the relation of depreciation to the various bases of rate-base determination.

termination of the rate base, according to this writer. The quotation follows:

A composite property, after a cycle of renewals has occurred for most of the component items, establishes a normal condition in which annual renewals required will not greatly exceed 5 to 10 per cent of such property, unless there is a large percentage of such property in a few large items.

A composite property having reached a normal condition, with annual renewals maintaining it in a state of efficiency, with no prospects of immediate abandonment on account of economic conditions, rendering service approximately as good as a new plant, is as desirable for service purposes as the new plant.

With the foregoing facts in mind, we believe the "Fair Value" of a property or the "Just Amount" for rates, with equity to both investors and users of the service, would be the cost of reproduction new less such depreciation as would . . . . be measured by the lack of capability of such property to render service. If the property renders less adequate service because it is not new, such service should be considered; if operating expenses are greater because the property is not new, such excess operating costs should be recognized; if there are items in need of repair or replacement on account of unusual or defective maintenance, usually designated as "deferred maintenance," allowance should be made. It should be remembered, however, that the replacement requirements will be such as will bring the property to a high state or normal operating condition, and not to bring the property to a new condition. A similar new plant would in a short time also require replacements, and the operating advantage of the new plant over the normal plant would be that the replacements in the new plant would be slightly longer deferred.[12]

Many court decisions and commission rulings reflect opinions similar in many respects to those presented by Mr. White. The following are typical:

. . . . If it can be demonstrated that the plant is in good operating condition, and giving as good service as a new plant, then the question of depreciation may be entirely disregarded.[13]

. . . . If, in fact, the capacity has remained the same, depreciation should not be a function of the rate base at all.[14]

[12] J. W. White, *Fundamentals of Accrued Depreciation in Public Utility Properties* (American Appraisal Company, 1931), pp. 7, 8, 14.

[13] *James A. Murray* vs. *Public Utilities Commission of Idaho*, P.U.R., 1915 F., 441.

[14] *Consolidated Gas Company* vs. *Charles D. Newton*, 258 U.S. 165.

. . . . I have made no deduction from or in the amounts found by me for the reproduction cost of the property or its value for the purposes of this case, for any so-called "accrued depreciation," but I have deducted the amounts shown by the uncontroverted evidence to be required to be expended to put the property used by the plaintiff in a condition equivalent to new.[15]

. . . . The plant and distributing system thus maintained is perpetual, and the repairs and renewals and replacements which, according to the evidence in the case have been made to it, eliminate both functional and physical or any kind of depreciation which would have taken place had it not been for the repairs, renewals, and replacements which have been made.[16]

The "depreciation reserve fund" is merely a sum supposed to be set apart to take care of depreciation with a margin over. . . . . It does not represent actual depreciation, but only what observation and experience suggest as likely to happen, with a margin over.[17]

The exclusion from the rate base of extensions and additions to the amount of $26,000,000 paid for from the depreciation reserve was clearly erroneous.[18]

We entertain grave doubt of the correctness of the theory that public utility properties should be valued according to their age and probable duration of life of their constituent parts. What a utility sells is service, not a pole, a mile of copper wire, or a generator. If it affords 100 per cent service the public is not concerned whether the generator furnishing the service is two or ten years old. The man who pushes the button does not obtain a dimmer light because the dam over which the water flows was built in 1912 instead of 1920, and no sound reason exists why a structure of this nature should be reduced in value by 14 or even 7 per cent. . . . .

The modern school of thought is that if a public utility property is kept in such a state of efficiency and maintenance that the public is furnished an extraordinarily efficient class of service, the matter of depreciation should not enter greatly into consideration by the rate-making body. We repeat, that what the public is interested in is service, and not the age or life of the properties which provide such service.[19]

[15] *Consolidated Gas Company of New York* vs. *William A. Prendergast et al.*, 6 F. (2) 243 at p. 271.

[16] *Nashville, C. & St. L. R. Co.* vs. *United States*, 269 Fed. 351.

[17] *Southern Bell Telephone & Telegraph Company* vs. *Railroad Commissioners of South Carolina et al.*, 5 F. (2d) 77, 95.

[18] *Illinois Bell Telephone Company* vs. *Pat H. Moynihan et al.*, 38 F. (2d) 86.

[19] The Alabama Service Commission, in the case of the Alabama Power Company, P.U.R., 1923 B, 41.

The depreciation reserve does not furnish a measure of the present condition as compared with new, and should not be deducted from cost to reproduce in order to find present value.[20]

Appellant objects to the application of this method (deduction of accrued depreciation) and insists that depreciation should have been ascertained upon full consideration of the definite testimony given by competent experts who examined the structural units, spoke concerning observed conditions, and made estimates therefrom. As these examinations were made subsequent to the alleged depreciation, for the definite purpose of ascertaining existing facts, we think the criticism is not without merit. Facts shown by reliable evidence were preferable to averages based upon assumed probabilities.[21]

The case for deduction of accrued depreciation.—Contrary to the foregoing opinions, it is recommended here that accrued depreciation computed on an age-life basis be deducted in determining the rate base, and that the depreciation reserve be regarded as the minimum deduction. It has been pointed out that depreciation charges of past periods represent recovery of investment on which the utility is no longer entitled to a return. It has been further demonstrated that even in the absence of such past charges the service life of the properties has expired and that the failure to deduct existing accrued depreciation results in inequitable charges to present and future consumers. The arguments voiced against the deduction of accrued depreciation invariably reflect a misunderstanding of the real nature of depreciation.

[20] *Worcester Electric Light Company* vs. *Henry C. Attwill et al.*, P.U.R., 1929 B, 69.

[21] Montana Public Service Commission, *Re Union Electric Company*, P.U.R., 1928 E, 396.

Other cases to support deduction of only observable depreciation, without respect to accrued depreciation, include the following: *New York Tel. Co.* v. *Prendergast*, 300 Fed. 822; *Southwestern Bell Tel. Co.* v. *City of Fort Smith*, 294 Fed. 102; *State of Kansas* v. *Southwestern Bell Tel. Co.*, 115 Kan. 236; *Monroe Gas, Light & Fuel Co.* v. *Public Utilities Com.*, 292 Fed. 139; *Landon* v. *Court of Industrial Relations*, 269 Fed. 433, 445; *Westinghouse Electric & Manufacturing Company* v. *Denver Tramway Co.*, 3 F. (2d), 285, 298; *McCardle* v. *Indianapolis Water Co.*, 272 U.S. 409.

Cases tending to support the deduction of an amount of accrued depreciation to be determined by some variation of the age-life method rather than by inspection and "observation" include the following: *City of Erie et al.* v. *Public Service Commission*, 278 Pa. 512; *City of Minneapolis* v. *Rand et al.*, 285 Fed. 818; *Reno Power, Light and Water Co.* v. *Public Service Com. of Nevada*, 298 Fed. 790; *International Ry., Co.* v. *Prendergast et al.*, 1 Fed. Supp. 623; *Idaho Power Co.* v. *Thompson*, 19 F. (2d) 547; *Railroad Commission of Louisiana* v. *Cumberland Tel. and Tel. Co.*, 212 U.S. 414.

The quotations on preceding pages present the case against the deduction of accrued depreciation about as well as it can be presented, and an analysis of the fallacies underlying these arguments builds a strong case for deduction of accrued depreciation. The major weaknesses in the opinion quoted above are these:

1. A misconception of the relationship of "operating efficiency" and the "condition" of the asset to rate-base determination.

2. The denial that expiration of service life decreases the future value-in-use of the asset, and the minimizing of the importance of the freedom from repairs and renewal costs incident to the use of actually new assets.

3. The failure to recognize the fact that under the retirement method of accounting present and future consumers may be overcharged for services rendered, even though the rates cover only replacements actually made.

4. The preference for "opinions of experts based on actual inspection" rather than actuarial computations based on age probabilities and experience.

5. A misconception of the meaning of, the reason for, and the difference between a depreciation reserve and a depreciation fund.

"*Operating efficiency.*"—It has long been recognized that the operating efficiency of a fixed asset does not decrease uniformly during its service life. The "output" of a machine, the service life of which has almost expired, may be 95 per cent to 100 per cent of that of a new machine. A street car twenty years old may carry as many passengers per day as one just put into service. A telephone pole seven years old performs the same service as one seven days old. But the fact that an asset is 95 per cent efficient is far from furnishing evidence that it is "worth" 95 per cent as much as a new one. Value-in-use depends upon the amount of future services to be received from the asset. If 40 per cent of the service life is gone, then 40 per cent of the cost (original or reproduction) should have been charged into operating expenses of past periods and only 60 per cent of that cost should be included in the rate base and be carried forward to be charged off against future periods. This is true regardless of the fact that the daily or yearly "efficiency" of the asset in terms of production is close to 100 per cent. To do otherwise overstates the "value" of the asset as based on the amount of future service life still remaining available for the use of

future periods—the only concept of value that is applicable to a "going" public utility.

Percentage "condition."—Courts and commissions are prone to include assets in the rate base at an amount which depends upon their "condition." The concept of "condition," however, as evidenced by material already presented, is related either to "operating efficiency" (discussed above) or to a 100 per cent condition which can be obtained by making all repairs, replacements, and renewals that are necessary at the present time to restore 100 per cent operating efficiency. Under this concept a building thirty years old but maintained in a perfect state of repair is in 100 per cent condition. A truck just out of the repair shop where every needed repair has been made is in 100 per cent condition, even though one-half of its service life is gone. And a public-utility plant composed of assets which average 50 per cent so far as remaining service life is concerned is in 90 per cent condition because an expenditure of an amount equal to 10 per cent of total cost (original or reproduction) would cover the expense of all repairs, replacements, and renewals necessary to restore 100 per cent efficiency.

In a street railway case,[22] where the city's expert reported accrued depreciation of 40 per cent to 45 per cent, the court said that so great a depreciation "would disclose a condition tending rapidly to dilapidation." In another case[23] it was stated that "if the engines were in the 50 per cent to 60 per cent condition claimed by the city, they could not be operated. Some engineers have expressed the opinion that a street railway system can be maintained indefinitely in an 85 per cent "condition," and it is hard to find a valuation expert who will admit more than 15 per cent depreciation in a utility property taken as a whole."[24] It is apparent that if depreciation is taken to mean "expired service life," an asset may be in 100 per cent "condition," as the term is used by public-utility experts, and still have accrued depreciation (as defined above) of 90 per cent, that is, it may be in only 10 per cent "condition" in so far as remaining service life is concerned. So long as the term "condition" can and does have such entirely different meanings in different situations, it will be difficult to develop and

[22] *Westinghouse Electric & Mfg. Co.* v. *Denver Tramway Co.*, 3 F. (2d) 285.

[23] Springfield (Illinois) Gas and Electric, 291 Ill. 209.

[24] Wilcox, *Depreciation in Public Utilities*, p. 22.

maintain a theory of depreciation and valuation that will not be subject to frequent misinterpretation by courts and commissions.

Capitalization of freedom from repairs.—It was repeatedly asserted in the foregoing quotations that a composite property ultimately reaches a "normal condition"; this means, correctly defined for the purpose in hand, a 50 per cent condition, where annual replacements and renewals are about uniform from year to year and will maintain the plant indefinitely in a state of high operating efficiency. It was further asserted that such a property is as desirable for service purposes as a new plant, that the only difference lies in the fact that in the new plant the costs of renewal and replacement are slightly longer deferred, and that for purposes of the rate base the plant in "normal condition" should be included at the same figure as the new plant. In the case as described the only difference may be that of deferred renewal and replacement costs; it must be noted, however, that a capitalization of the present value of these future charges which will be avoided by the owners of the new plant may well equal 50 per cent of the cost of the property. Therein does lie the difference in the value-in-use of a new plant and of a "normal condition" plant; and therein lies the justification, from the standpoint of a fair service charge to consumers, for deducting accrued depreciation of about 50 per cent from such a plant, even though it may be in 100 per cent "condition" as defined by the utility experts, and even though the quality of the service rendered and the operating efficiency of the plant may be about equal to that of a new plant, accrued depreciation should be deducted in determining the rate base.

"Observed" depreciation.—In many of the foregoing court and commission decisions there is expressed a distinct preference for the opinion of the "expert" engineer and accountant, when that opinion is based on actual observation rather than upon "mere calculations based on assumed probabilities and averages." Serious consideration suggests two objections to such preference. In the first place, the opinions of "experts" are subject to very wide margins of error; in the second place, there is some evidence that the desires of the employer may, in many instances, influence such opinions.

On the first point, Wilcox comments:

> The interior of a turbine cannot be inspected without the machine being taken down. Many of the parts of a car cannot be inspected while the car is

in service. Building foundations and the interior frame work of the walls and floors are concealed. Pipes and conduits are buried. Who can tell by the most elaborate inspection and the most painfully exact measurements how much a street railway or a gas plant in all its infinite variety of parts has deteriorated?

. . . . The utility cannot set up annual depreciation on any scientific basis without estimating the lives of the units of property, and these estimated lives, with the actual ages, which should be a matter of record, and the costs new and salvage values, furnish the complete data for computing accrued depreciation. . . . .

. . . . The age-life method is dubbed "theoretical" and the inspection method "actual," though in the former the ages are a matter of fact and the lives are estimated primarily from actual experience, while in the latter recorded facts are discarded and the amount of depreciation is determined by the practiced eye of the appraiser. Depreciation determined by inspection might better be called "visible depreciation;" it is almost inevitably less than the full amount of actual depreciation. . . . .[25]

The experience of many large companies in the public-utility field (notably the American Telephone and Telegraph Company and the Associated Bell System, among others) furnishes ample evidence that depreciation can be "forecast with a reasonable approach to accuracy." A study of the methods actually employed, and of the relatively slight percentage of error normally encountered, is convincing proof that the age-life method is not so "theoretical" as the utility experts insist, just as certainly as the inspection method is not "actual" in any real sense of the word.[26]

The question of the honesty and integrity of expert witnesses is beyond the scope of the present discussion. The reader is referred to a recent publication in which this problem is presented more completely.[27] Here is offered only a reflection of the attitude of the Interstate Commerce Commission on this question:

Perhaps the most serious infirmity of opinion evidence is that a witness may be selected at the will of the one producing him. A fact must be estab-

[25] *Ibid.*, pp. 5, 33, 39.

[26] For a detailed study of methods of determining age-life estimates and depreciation rates the reader is referred to *Depreciation*, prepared by the Public Service Commission of Wisconsin (New York, 1933).

[27] J. H. Gray, and J. Levin, *The Valuation and Regulation of Public Utilities* (New York: Harper & Bros., 1933), pp. 86–96.

lished by those who have knowledge of it, who were present and saw it, for example, but an expert can be brought from the ends of the earth, and a dozen may be rejected until the right one is found. Given time and the money, almost any opinion may be had within certain limits.[28]

Depreciation reserves and funds.—Many court decisions and a few commission rulings reflect a complete misconception of the nature and functions of depreciation funds and of depreciation reserves. For example, one argument in favor of retirement accounting is that depreciation accounting builds a larger reserve (or reserve fund) than will ever be needed for actual replacements. Similarly, an objection to the deduction of accrued depreciation is that the reserve (or reserve fund) collected from consumers in the form of depreciation charges "belongs" to the public-utility company and not to the consumers; consequently it should be included in the rate base without any deduction. An analysis of the real nature of the depreciation reserve and the corresponding fund (if any) should completely destroy any weight attached to such arguments as those above.

The depreciation reserve (also called depreciation allowance, allowance for depreciation, reserve for depreciation, accrued depreciation) represents the total amounts which have been charged to consumers in prior periods (in the form of service rates) for the decrease in the value-in-use of fixed assets "used and useful" in furnishing the service; against this reserve have been charged renewals and repairs which have been made to eliminate such decreases in value, and the cost of assets retired. The net balance in the reserve is, therefore, the total *net* decrease in the value-in-use of fixed assets which are not yet retired nor replaced. It is best understood, perhaps, as a deferred deduction from the asset account itself, an accumulation of amounts that might have been entered directly to the asset account and thereby deducted directly from that account, but which have been "suspended" or "deferred" in the special reserve account in order that the cost new of the assets might not be disturbed. If the asset account be thought of as being composed of two parts, the asset account proper reflecting cost (new) and the reserve account reflecting decreases in value due to depreciation, then the function of the reserve account will be better understood—that function being the accumulation of decreases in value of fixed assets caused by their use in furnishing service to custom-

[28] Texas Midland Case, 75 I.C.C. 1,136.

ers; of course this decrease is at the same time charged to the consumer through the depreciation expense account and included in the service rates along with the other operating expenses.

It is immediately apparent that the charge to operating expense for depreciation either necessitates a higher service rate to consumers or reduces the amounts payable to stockholders in the form of dividends. In other words, the depreciation charge tends to draw more assets into the business through higher service rates or to hold assets in the business through a reduction of profits and, therefore, of dividends. Therefore, other things being equal, the result of the depreciation charge is that the total of the assets of the business (at cost new) is larger by the amount of the total accrued depreciation. This fact often leads to the mistaken assumption that a depreciation fund equal to the total accrued depreciation must therefore exist, that the additional assets resulting from the depreciation charge must of necessity be placed in a segregated fund out of which expenditures for replacements and renewals may be made. Such a procedure *could* be followed. Normally, however, such a fund would be much larger in amount than demanded for actual expenditures for replacements (remembering the tendency to a norm of about 50 per cent "condition") and it is, therefore, invested in additional fixed assets. In other words, the assets (funds) drawn into or held in the business as a result of the depreciation charge, in so far as they are not needed for replacement of the depreciated assets, are ordinarily used for the purchase of new additional assets, thereby avoiding the necessity of financing expansion through the issue of new securities. It can be demonstrated that over a period of time a public-utility company can about double the amount of its fixed assets (at cost) without any increase in investment, merely by investing in new additional fixed assets the funds resulting from the depreciation charge, in so far as they are not needed for replacements. For example, a company with a total investment in fixed assets new of $10,000,000, could have with the same investment, when it has reached a normal "condition" of about 50 per cent, fixed assets costing new about $20,000,000. The item on the balance sheet would of course appear as follows:

Fixed Assets	$20,000,000	
Less: Reserve for Depreciation	10,000,000	$10,000,000

Only under unusual conditions would all of the assets resulting from the depreciation charge be segregated in a depreciation fund. If such funds are not needed for additional fixed assets they may be given back to the stockholders or other investors through redemption of bonds or of stock.

The Interstate Commerce Commission expresses its views on this question as follows:

. . . . These quotations leave no doubt that under this view of the matter, the depreciation charge is based on cost of property which has been consumed or used up in service during the year; that the depreciation reserve is intended to represent the accumulated total cost of property which has been used up in this way but has not yet been written out of the investment account; and that money corresponding to this reserve has gone into the general funds of the company and thence into property which has taken the place of the part which is deemed to have been used up, thus maintaining the capital unimpaired. . . . .

It is not the new property which has been supplied through depreciation charges upon which we believe the company should have no return. It is rather the old property, or service capacity, which has been used up and which the new property replaces.[29]

[29] 177 I.C.C. 351 at 399 and 407.

CHAPTER VII

BASES OF DEPRECIATION

Physical capital versus money capital.—Under present conditions of fluctuating prices it would seem necessary, for many purposes, to make a sharp distinction between "capital" and "money." The problem which is under consideration in these pages, that of the choice of a base for depreciation charges, demands that such a distinction be made. The first principle of sound investment is the safety and assurance of a return *of* and a return *on* "capital," but the full meaning of that principle is uncertain until "capital" has been defined to mean either a sum of "money" (dollars) or a specific quantity of physical assets or "purchasing power." In these pages there is stressed the importance of the latter concept of capital.

In preceding pages this problem has been considered from the standpoint of a return *on* capital of a privately owned public-utility company. In this section a return *of* capital will be considered—the proper basis and method for computing the annual depreciation charge, with primary attention to public-utility companies.

During recent years there have appeared in various accounting publications many discussions of this problem from the standpoint of competitive industrial and commercial enterprise. From this standpoint the choice between original cost and reproduction cost as a basis for the annual depreciation charge is related to balance-sheet values of fixed assets, the replacement of the assets when fully depreciated, the annual costs of operation, and therefore the net profit from operation. The choice must be made with full consideration of all of these factors.[1]

The original-cost basis.—The original-cost basis has behind it the weight of authority. The majority of writers in the field of accounting have expressed their preference for this basis. The comprehensive bibliography compiled by Justice Brandeis (referred to in his dissenting opinion in connection with the United Railways case[2]) reflects an almost unanimous preference for original cost. Prevailing practice also

[1] For a summary of the arguments relative to the choice of a depreciation base in competitive industry, see *The Accountants' Handbook* (Revised edition), pp. 597, 749.

[2] *United Railways and Electric Company* v. *West et al.*, 280 U.S. 259.

favors this basis, and income-tax procedure, except in a few "special cases," demands that depreciation for the purpose of determining taxable income be based on original cost.

The reproduction-cost basis.—In recent years, however, considerable support has been given to reproduction-cost as a basis for depreciation charges due to the fact of almost continuous price fluctuation. On this basis depreciation may be considered as an approximate statement, in present monetary units, of an amortization of original costs; and much can be said in favor of cost-and-profit statements that reflect current economic and business conditions.

Non-regulated versus regulated enterprise.—Even the proponents of the original-cost basis admit that, under competition, selling prices will not be governed by the use of one basis or the other—that the total amount charged for the product will be independent of the basis of depreciation. For the non-regulated, competitive business, then, the choice between the two methods is purely a matter of whether the additions to surplus (during a period of high fixed property costs) should all be labeled operating profits, or whether the portion due to past increases in fixed property values should be segregated as capital increases. Conversely, in a period of low prices, the only point at issue is whether or not past decreases in the (dollar) value of capital assets should be segregated from current operating profits or losses.

Even in competitive business there is some trend toward the use of reproduction costs; but, admitting for the sake of argument, that in competitive business there may not be sufficient reason for basing depreciation on reproduction costs, the argument does not carry over into the public-utility field.

For public utilities, a much more important issue hinges on the choice between the two bases. In this, a non-competitive, regulated industry, the selling price of the service *is* dependent on the choice of depreciation bases. If reproduction costs are not allowed in a period of high prices, there is no way open for a complete recovery of fixed (physical) capital except by restricting dividends below a fair return or by securing new capital. Conversely, in a period of low prices, service rates will not reflect the lower prices of fixed assets unless depreciation is computed on the basis of reproduction costs, and recovery of capital will exceed in purchasing power the original investment.

In a regulated industry the issue is much more than the selection of

a *method* of showing profits; it is a vital factor in the determination of the service rate—the selling price of the product or service. Hence arguments which might prevail in competitive enterprise purely on a basis of accounting practice must be allowed no weight in the public-utility field where a "fair" price for the service is the primary issue.

Fundamental issues of depreciation basis.—The problem of choosing between reproduction cost and original cost as a basis for the depreciation charge raises these fundamental issues:

1. Should costs provide for replacement of dollar (money) capital or physical capital?

2. Should product or service costs (and selling prices) include a charge for the original cost of the portion of fixed properties consumed in production or for the current effective (reproduction) cost of equivalent properties?

3. Will depreciation on current reproduction costs provide for replacement of fixed properties at some future period at a price level which cannot be determined in advance?

4. To what extent will disparity between specific prices and general prices result in a differential between a return of physical capital and a return of economic capital?

All of these issues as related to the problems of the privately owned public-utility company will be considered in subsequent sections.[3]

Fluctuations in general price level.—The relation of a fluctuating general price level to the choice between original cost and reproduction cost (new) as a basis for rate-base determination has been considered in preceding sections. The relation of this phenomenon to the periodic depreciation charge and the deduction of accrued depreciation from the

[3] There must be recognized under any method of computing depreciation and determining the rate base the impossibility of predetermining exactly such factors as total business volume, total income, total operating expense, total service life of properties and their salvage value at retirement, and many other factors. Service rates must be scheduled in advance of actual operation, obviously, and estimates must be made as accurately as possible of the foregoing factors. Regardless of the basis of "valuation" and of depreciation bases or methods, errors will occur. The net income will usually vary from the estimate one way or the other, and only omniscience on the part of company officials and utility commissioners could prevent this. If the estimates are prepared carefully, however, the errors should not be serious and should tend to counteract one another. The surplus account of the company may well operate as a reserve to equalize dividends and to offset the effect of these variations from the estimate.

rate base present similar problems. Under these conditions of price change, depreciation charges based on original cost, and a fair return on a rate base which includes properties at original cost less accrued depreciation, result in charges to the customer and returns to the investor which, though uniform in terms of dollars, are variable in terms of purchasing power. Since these uniform price-level changes really reflect actual changes in the value of the monetary unit it would seem reasonable and equitable to adjust, in so far as possible, the costs to the consumer and the return to the investor until they are uniform in purchasing power rather than in terms of money—a stabilized *real* income to the investor and a constant current competitive cost to the consumer.

The stabilized real income to the investor can be achieved very simply by including the properties in the rate base at reproduction cost less the accrued *percentage* of depreciation.[4]

The money return received on this basis will have the same purchasing power as would the money that would have been received if the changes in price levels had not taken place—it would be an actual stabilized real income.

The constant charge to the consumer (constant in terms of current competitive costs—in terms of purchasing power) is only slightly more complicated. Current operating expenditures are already at the new-price level. Only depreciation and the cost of the "fair return" to investors need adjustment. The periodic charge for depreciation may be a fixed percentage of the reproduction cost (new) of the properties, a constant percentage applied to a changing base, which results in a charge that fluctuates in terms of dollars but remains constant in terms of purchasing power for a constant physical quantity of properties. A uniform charge (in terms of purchasing power) for the "fair return" to investors has already been discussed in foregoing chapters.

Illustration of reproduction-cost base.—To illustrate the procedure de-

[4] By accrued *percentage* of depreciation is meant the result obtained by applying the percentage of expired service life to the reproduction cost (new) of the asset. For example, properties costing originally $100,000 with accrued depreciation of $40,000 based on original cost—40 per cent—would be included in the rate base at their reproduction cost (new) say of $150,000 less accrued depreciation of $60,000—40 per cent of reproduction cost (new). On subsequent pages (pp. 74–75) it is demonstrated that this method applies to a single asset or to a group of assets purchased at the same price level, but not to total assets if purchased at different price levels.

scribed above, assume properties costing $1,000,000. Their reproduction costs new in the four years succeeding the year of purchase are respectively, 90, 100, 110, and 120 per cent of their original cost, and there are corresponding changes in the general price level. Depreciation is charged into the expenses of each year at 5 per cent of reproduction cost. A reserve for repairs is created each year equal to 2 per cent of reproduction cost and from this reserve expenditures are made as follows: second year, $3,500; third year, $7,000; fourth year, $11,000; fifth year, $15,000. In Table III is presented in tabular form a summary of service costs (depreciation, repairs, and fair return) and of investor returns. For comparison corresponding figures are presented to show the results of the application of the compound-interest method to the same situation computed at 6 per cent. It should be noted that the sinking-fund method would yield results identical to those shown for the compound interest method.

The use of the straight-line method, the reproduction-cost base, and the reserve for repairs results in a constantly decreasing cost to the customer (in terms of purchasing power). This phenomenon is inherent in the straight-line method. It should be noted that this decrease is uniform (when adjusted by index numbers), being $3,000 each year ($1,000,000 × 5 per cent × 6 per cent) the amount by which the return is decreased each year as the result of deducting from the rate base the amount of accrued depreciation.

It is evident from the figures above that under the conditions assumed a constant periodic service charge (in terms of purchasing power) for continued use of specific assets can best be secured by computing depreciation by the compound-interest or sinking-fund method on a reproduction-cost base, and by providing for repairs and maintenance through the establishment of a reserve. Approximately the same uniformity appears to result from the use of the straight-line method on a reproduction-cost base, with the actual expenditures for repairs charged into cost. This similarity is more apparent than real, however, for such a result would obtain only if repairs increased at a certain rate, which would be the exception rather than the rule.

Disparity between specialized and general price levels.—The illustrative case above does not describe accurately the conditions found in actual practice, for the reason that it fails to reflect the effect of two factors almost always present in the public-utility enterprise, viz.,

TABLE III

COMPARISON OF DEPRECIATION METHODS—REPRODUCTION-COST BASE

INDEX OF P. U. CONSTRUCTION COSTS	YEAR	REPRODUCTION COST OF PROPERTY	DEPRECIATION CHARGE		ACCRUED DEPRECIATION—BEGINNING OF YEAR		ACCRUED DEPRECIATION ADJUSTED TO REPRODUCTION COST		RESERVE FOR REPAIRS	
			Straight-Line Method	Comp.-Interest Method	Straight-Line Method	Comp.-Interest Method	Straight-Line Method	Comp.-Interest Method	Additions	Expenditures
100	1	$1,000,000	$50,000	$27,185					$20,000	
90	2	900,000	45,000	25,934	$ 50,000	$ 27,185	$ 45,000	$ 24,467	18,000	$ 3,500
100	3	1,000,000	50,000	30,545	95,000	53,169	100,000	56,001	20,000	7,000
110	4	1,100,000	55,000	35,615	145,000	83,664	165,000	95,200	22,000	11,000
120	5	1,200,000	60,000	41,184	200,000	119,279	240,000	142,909	24,000	15,000

INDEX OF P. U. CONSTRUCTION COSTS	YEAR	RATE BASE—REPRODUCTION COST LESS PER CENT OF ACCRUED DEPRECIATION		6 PER CENT "FAIR RETURN" ON RATE BASE		TOTAL DEPRECIATION, REPAIRS, AND FAIR RETURN			TOTAL DEPRECIATION, REPAIRS, AND FAIR RETURN ÷ REPRODUCTION-COST INDEX		
						Straight-Line Method		Comp.-Interest Method Including Additions to Reserve for Repairs	Straight-Line Method		Comp.-Interest Method-Reserve for Repairs
		Straight-Line Method	Comp.-Interest Method	Straight-Line Method	Comp.-Interest Method	Including Additions to Reserve for Repairs	Including Actual Repairs		With Reserve for Repairs	With Actual Repairs	
.....	1	$1,000,000	$1,000,000	$60,000	$60,000	$130,000	$110,000	$107,185	130	110.0	107.185
.....	2	855,000	875,537	51,300	52,532	114,300	99,800	96,466	127	110.9	107.185
.....	3	900,000	943,999	54,000	56,640	124,000	111,000	107,185	124	111.0	107.185
.....	4	935,000	1,004,800	56,100	60,288	133,100	122,100	117,903	121	111.0	107.185
.....	5	960,000	1,057,091	57,600	63,425	141,600	132,600	128,609	118	110.5	107.185

changes in public-utility construction costs not corresponding to changes in general price levels, and the existence in the utility field of a very large percentage of fixed (dollar) return investment.

Both of these factors have been discussed at some length in preceding sections in connection with the alternative-cost bases for rate-base determination, and further discussion at this point is not warranted. On pages 22–29 it was pointed out that the discrepancy between general prices and public-utility construction costs have not been, since 1913, as serious as might be supposed, and evidence was presented pointing to this conclusion. It was there demonstrated that this discrepancy affected only the "purchasing power" of the return to investors—their real income—and that the effect was relatively insignificant, much less serious than that resulting from the use of original costs.

"Fixed-return" investments.—On pages 12–15, the distribution of public-utility investment between common stock on the one hand and bonds and preferred stock on the other, was discussed at some length. The disproportionate effect on common-stock returns of the use of reproduction costs in rate-base determination was recognized and a solution suggested. A somewhat similar analysis is applicable to the use of reproduction cost as a base for the annual depreciation charge.

It should be noted, however, that although the choice of a depreciation base does affect the charge to the consumer, it does not affect net profit; any excess (or deficiency) in the depreciation charge which is caused by using the reproduction-cost basis is added to (or deducted from) the "special" depreciation reserve. Therefore, since the amount available for dividends is not affected by the choice of depreciation bases, the element of fixed-return investment is less of a problem in this connection than in the determination of the rate base.

Maintenance of "real" capital.—The argument is frequently advanced that depreciation charges based on reproduction cost may not provide the amount of capital needed for the replacement of the asset when it has been completely depreciated and is ready for retirement, that the amount of capital needed for replacement depends upon the price level at retirement rather than on price levels during the useful life of the asset. The argument is usually presented in some such form as this: Assume that an asset with a service life of five years costs $1,000 when the index of construction cost is 100; depreciation is charged each year throughout its life at 20 per cent of the current reproduction

cost; the construction-cost indexes for the five years are, respectively, 100, 120, 110, 130, and 150. Total depreciation charged is, therefore, $1,220, and fails by $280 to provide for replacement at a cost of $1,500.

This case illustrates a very ingenious argument that full replacement of physical capital is not secured by depreciation charges based on reproduction costs. A close analysis, however, reveals serious fallacies. If the money recovered from customers through the depreciation charge should be returned to investors at the time of recovery, it has at that time a purchasing power equivalent to the reproduction cost of the portion of the asset value that has expired. For example, if $240 be returned to the investors in the second year, it has at that time a purchasing power equivalent to the original $200 paid for that portion of the asset in the first year. Therefore, recovery of capital is complete at that point. If the investor does not use that $240 in such a way as to retain its purchasing power, that is a matter of *his* investment policy. The most that any depreciation policy can do is to recover investments in amounts which have at the moment of their recovery a purchasing power equal to that at the time of the original investment.[5]

In actual practice, however, amounts recovered through depreciation charges are not returned to investors but are invested in additional properties, or in replacement of properties fully depreciated. In such a case there is automatically secured a constant purchasing power of the original investment, and full provision for replacement at retirement is secured by charging depreciation on the reproduction-cost bases. This fact can be very easily demonstrated by a simple hypothetical case, as follows: At the end of 1912 properties costing $1,000,000 have been acquired, with an average service life of 20 years. During the next 20 years, through 1932, depreciation is written into expense at 5 per cent of the current reproduction cost of the properties on hand, and all amounts collected through these charges are reinvested in additional properties. Table IV presents the results.

The figures in Table IV demonstrate that if depreciation is based on

[5] The statements here and subsequently with respect to "purchasing power" are subject to a degree of qualification. In preceding chapters it has been noted that changes in general prices and in public-utility construction costs do not always coincide. Also, there is usually a "lag" in the application of reproduction costs, and this fact may result in a discrepancy between the purchasing power of investments returned to the investor and their original purchasing power. The effect of this "lag" is discussed more fully on pp. 61–62.

TABLE IV

PROVISION FOR REPLACEMENT BY CHARGING DEPRECIATION AT REPRODUCTION COSTS

(000's omitted)

(1) Year Ended	(2) Public-Utility Construction Cost Index	(3) Properties at Original Cost	(4) Properties Adjusted to Cost Index of 1913	(5) Depreciation at 5 Per Cent of Original Cost	(6) Depreciation at 5 Per Cent of Reproduction Cost = Properties Added	(7) Properties at Current Reproduction Cost	(8) Rate Base—Properties at Reproduction Cost less Per Cent of Accrued Depreciation
Prior Year	.....	$ 1,000	$ 1,000	.....	.....	$ 1,000	.....
1913	100	1,050	1,050	$ 50	$ 50	1,050	$ 1,000
1914	98	1,102	1,103	53	52	1,081	980
1915	101	1,158	1,158	55	56	1,170	1,010
1916	121	1,228	1,215	58	70	1,470	1,210
1917	154	1,322	1,276	61	94	1,965	1,540
1918	175	1,434	1,340	66	112	2,345	1,750
1919	191	1,562	1,407	72	128	2,687	1,910
1920	227	1,722	1,477	78	160	3,353	2,270
1921	202	1,871	1,551	86	149	3,133	2,020
1922	180	2,011	1,629	94	140	2,932	1,800
1923	183	2,160	1,710	101	149	3,129	1,830
1924	181	2,315	1,796	108	155	3,251	1,810
1925	179	2,476	1,886	116	161	3,376	1,790
1926	178	2,644	1,980	124	168	3,524	1,780
1927	175	2,817	2,079	132	173	3,638	1,750
1928	176	3,000	2,183	141	183	3,842	1,760
1929	179	3,195	2,292	150	195	4,103	1,790
1930	172	3,392	2,407	160	197	4,140	1,720
1931	162	3,587	2,527	170	195	4,094	1,620
1932	148	3,774	2,654	179	187	3,926	1,480
Total	3,282	$44,820	$35,720	$2,054	$2,774	$59,209	$32,820

NOTES

Col. 2: The index numbers represent the construction costs actually current in those years, as described on pp. 22–24 preceding.

Col. 3: The figure for each year is increased by the amount in Column 6.

Col. 4: The amounts in this column increase 5 per cent each year, and represent the situation as it would be if prices had remained static. It also reflects actual properties at 1913 prices.

Col. 5: The amounts here equal 5 per cent of the original cost (Col. 3) at end of preceding year.

Col. 6: The amounts in Column 7 at the end of the preceding year multiplied by 5 per cent and the result adjusted for the change in index numbers yield the amounts in this column.

Col. 7: These amounts are built up by adjusting figure for preceding year for changes in the index number and adding additions during current period at cost.

Col. 8: The amounts in this column are computed by determining the *percentage* of accrued depreciation and reducing the amounts in Column 7 by this percentage. For example for the year 1932 the computation is as follows:

$2,654,000 − $1,000,000 = $1,654,000 = amount of accrued depreciation on 1913 base price.

$$\$3,926,000 - \left(\$3,926,000 \times \frac{\$1,654,000}{\$2,654,000}\right) = \$1,480,000 = \text{"sound value" at end of 1932.}$$

reproduction costs, and if all amounts secured through these charges are reinvested in additional properties or replacements during the year of their recovery, the purchasing power of the initial investment is maintained intact; that is, the reproduction cost of all properties, less the percentage that has been charged into operation as depreciation, is at all times equal to the initial investment adjusted by changes in the index of construction costs. The final column of the table presents proof of this fact. And replacement is fully provided for, because amounts recovered through depreciation charges are immediately reinvested in properties that are subject to the same price-level changes as the other properties. For example, at the end of the twenty-year period the total properties have a "sound value" (reproduction cost less the percentage charged off as depreciation) of $1,480,000 as compared with an initial investment of $1,000,000, the increase corresponding exactly to the increase in the index from 100 to 148 during the twenty-year period.

Amounts recovered through depreciation charges must be returned to investors, invested in additional properties, invested in securities, or be allowed to lie idle. The last is a matter of financial policy and is independent of the method of depreciation; also, to invest in fixed-return securities will not secure the effect of price-level changes. It has been demonstrated on preceding pages that amounts recovered and returned to investors have the same purchasing power as had the corresponding initial investments. And the illustration above shows that if these amounts are reinvested in additional properties they retain their purchasing power and provide fully for replacement of assets to be retired when fully depreciated. From the point of view of the investor, then, the case for the reproduction-cost basis for depreciation seems fairly well established.

The results obtained by the use of reproduction cost as a basis for computing depreciation and determining the rate base must be qualified to some extent because of the necessary "lag" incident to giving effect to new price levels. It is impossible to predetermine price levels exactly, and therefore past indexes, adjusted, perhaps, for extraordinary impending price changes, must be the basis for the future service-rate schedules. The effect of this "lag" in one period may be offset in a subsequent period when price changes are in the opposite direction. In a long-sustained movement in one direction or the other, the effect is cumulative but does not amount to a large percentage of the total. In

the foregoing illustrative case if it should be necessary to use as the depreciation base each year the index of the preceding year (and if depreciation amounts are either returned to investors or reinvested in additional assets or replacements, as assumed in this case) the effect on the fair return (at 6 per cent) for the twenty-year period would be a decrease of approximately $28,800, representing only 1.5 per cent of a total fair return of $1,969,200 during the entire twenty-year period.[6]

In the same case the effect of this one-year "lag" on the depreciation charges would be an understatement of the total depreciation for the twenty-year period—an error of $10,000 as compared to a total correct amount of $2,774,000. It is evident that this understatement of 0.4 per cent is not serious.[7] It should be noted that under an original-cost basis the "error" in depreciation would have been $720,000, or 26 per cent.

[6] Total rate base for 20 years in absence of "lag" is $32,820,000; with a one-year "lag," $32,340,000. Total return at *current* reproduction costs is therefore $1,969,200 —with a one-year "lag," $1,940,400. The decrease is therefore $28,800, or 1.5 per cent of $1,969,200.

[7] Total depreciation at *current* reproduction cost was $2,774,000. If the index number of the preceding year had been used, the total depreciation would have been $2,764,000, or ($59,209,000 − $3,926,000) × 5 per cent. The error due to a one-year lag would therefore be $10,000 or about 0.4 per cent of the correct total.

CHAPTER VIII

GENERAL CONSIDERATIONS AND SPECIAL PROBLEMS

Economic "injustice" of original costs.[1]—It can be demonstrated rather conclusively that the use of the original-cost basis may have serious results from a broad social and economic point of view. It has previously been shown that in a period of relatively high prices utility rates may be artificially low because the rate of return and the depreciation charge are based on original construction costs incurred in previous low-cost periods; utility patronage may thus be encouraged because of rates comparatively lower than those of alternative products or services, and may increase so greatly as to demand additional construction. Interestingly enough, however, such new construction at the current high costs necessitates increases in rates, and the additional patronage demanding the construction may not be able to pay the higher rates. If the rates are increased just enough to cover the full cost of *all* the service on old business as well as new, the new business does not pay the full differential original cost of the service it demands, but only the average cost. If the new business should be charged the *full* cost, as it would if a separate company were formed to furnish the service, much of the new business would almost certainly not materialize. It would seem socially and economically unwise to force a utility to engage in new construction at high prices in order to furnish service that is not worth to the consumer its full cost of production, and at the same time to encourage the withdrawal of that patronage from alternative services where its full cost could possibly be paid. The net result, of course, is higher rates in subsequent periods to all consumers, even to those for whom the additional construction was not needed.

Conversely, in other periods, as other prices and costs are lower relatively than utility rates (artificially held up by the use of an original-cost basis), patronage is drawn from public utilities to alternative sources of supply; this patronage could pay to the utilities the full (present) cost of furnishing the service but is unable to pay, in a competitive market, the higher cost necessitated by the "carryover" of the

[1] For a discussion of similar economic issues in connection with railroads see H. G. Brown, *Journal of Political Economy*, XXXIII, 505–30.

higher original construction costs incurred in a previous high-cost period. It is maintained that patronage able and willing to pay the full production cost of public-utility service should not be denied that service under regulation, when they would certainly receive it under competitive conditions.[2]

Mal-location of industry.—It is possible to demonstrate that some mal-location of industry may result from the strict application of the original-cost basis. For example, assume two alternative prospective locations for an industrial plant; assume further that an analysis of comparative advantages, computing relative power costs on a reproduction-cost basis, indicates that location A has a very slight advantage; however, power facilities at A were constructed during a high-cost period, and those at B during a low-cost period; therefore, on an original-cost basis, power costs at A are substantially higher than at B. This fact alone may throw the advantage to B and the plant be located there. It is submitted that under the above assumptions B may not be the proper location for this industrial plant; other advantages remaining in favor of A, eventually the costs of production at B may exceed those at A. It is therefore evident that as a result of the application of the original-cost method business enterprises may be located at points not possessing permanently the lowest-cost advantages. Other examples might be suggested which would illustrate the possibility of unjustified development of certain residential sections, or the equally unjustified retardation of other sections, due primarily to a temporary maladjustment of rates for transportation, power, light, water, or gas service—all caused by the application of the original-cost basis.[3]

Public-opposition.—In choosing between these two primary bases of rate-base determination and depreciation, consideration must be given to the possibility of reducing to a minimum the opposition of the consumer. The "public" (largely consumers) very naturally approves

[2] It should further be indicated that while rates based on reproduction cost will encourage just enough construction to meet the economically justified patronage, the extra earnings of added patronage need not cover *full* cost but only the *extra* costs (under a condition of decreasing costs in the industry)—the differential costs. Rates may then be averaged down, resulting in still more patronage, more construction, still lower rates, so long as the principle of decreasing costs is operative in the industry.

[3] The force of this argument depends, of course, upon the extent to which service rates are affected by the choice of cost bases. See pp. 19–20.

of low rates and is inclined to bring political pressure to bear to reduce "high" rates, or to resist increases in "low" rates. It would seem from a rational point of view that "high" rates in high-price periods (under a reproduction-cost basis) are less likely to cause public opposition than "high" rates in low-cost periods (under an original-cost basis, when construction has occurred in previous high-cost periods). Increases in rates, under a reproduction-cost basis, should be more feasible when other prices are rising than the maintenance of high rates under an original-cost basis when other prices are declining. Actually, however, it appears that increases in rates, even when equitable, meet with greater opposition than does the maintenance of high rates when equity to all concerned demands their reduction. To the extent that this irrational public attitude prevails, original costs will meet with less opposition than will a reproduction-cost basis.

Auxiliary problems.—As the reproduction-cost basis has been administered to date, many additional perplexing problems have been injected, not all of which are always present under an original-cost basis. These have appeared under various headings, including "going value," "cost of establishing business," "sacrifices of investors in development period," "development costs," "past losses," "losses of early years," "intangibles," "expenses originally incurred that would not now be necessary" (grading, filling, obsolete methods of construction), "costs not originally incurred that would be necessary now" (tearing up and relaying paving not originally necessary), and many others. These are important problems and not easy of solution. Complete discussion is not appropriate at this point, but this much may be said: In so far as these items are allowable under an original-cost basis they should be allowed under reproduction costs. However, their "reproduction cost," so called, can be computed definitely and on a logical basis only by applying index numbers to their original costs. This does not agree entirely with the "competitive-rate" viewpoint, but any other solution introduces unlimited opportunity for estimates, guesses, disagreements, inexactness, etc. The inclusion of intangibles in the rate base is pure guesswork unless their computation is related definitely to their cost.

Valuation of "standby" properties.—A standby plant may be defined either as a peak-load plant or as an emergency plant which is equipped to furnish service upon short notice in case of failure of the base-load

plant or the purchase source. These "legitimate" standby properties should of course be included in the rate base on the same basis as other productive properties.

A special problem often occurs when obsolete plants have been purchased to make way for utility service from outside sources. Usually the result is a decreased service rate and increased efficiency. The question arises as to whether such plants should not be included in the rate base even though they are not technically properties "used and useful" in furnishing the service. To exclude them means that investors will never get a return on or a return of their investment in these properties; this seems unfair in view of the economies secured to consumers by the expenditure. Therefore, it is rather general practice to include such properties in the rate base and to amortize their costs over a period of years. Usually they are listed as "standby" properties; theoretically they are supposed to furnish service if the usual sources fail to do so. Actually, they are seldom or never used for this purpose, and many of them could not produce the service if called upon. Nevertheless, from the standpoint of the general development of the industry, the practice of their inclusion is probably justified; otherwise such purchases would not be made, progress in the industry would be retarded, and consumers would be deprived of the increased efficiency and the lower service rates which result. It seems, therefore, that everyone gains and no one loses by their inclusion.

If properties "used and useful" in the business are included in the rate base at their original cost, the same basis will naturally apply to the "standby" properties described above. If the reproduction-cost basis is applied to these other properties, the problem of pricing these "standby" plants is more difficult of solution. Under no circumstances will these plants be "reproduced"; they will not even be replaced by substitute properties. To compute a hypothetical cost of reproduction is, therefore, absurd on the face of it. The only type of "reproduction costs" that is at all "reasonable" in this connection would seem to be original costs adjusted by index numbers. This basis would have the advantage heretofore described, that of "stabilizing" to some extent the investors' real income; it would also cause the service rates to consumers to fluctuate more uniformly with the prices of alternative services. It can be said to cause a "competitive" rate only under the

assumption that a present buyer of these "standby" properties would be quoted a price that would be based primarily on present utility construction costs—an assumption hardly justified by the actual conditions under which these properties are actually acquired in practice.

There are other problems occurring not infrequently which for the sake of consistency, if nothing else, should probably be solved in about this same fashion. One author insists that reproduction costs (based on appraisals and estimates) cannot be applied to situations such as the following: (1) properties purchased at less than cost (perhaps for only a nominal amount) through receivership or foreclosure sales, and later developed to earning properties; (2) properties purchased for consolidation purposes at more than original cost (or reproduction cost), but resulting ultimately in net savings to consumers.[4] It must be granted that a reproduction-cost basis of the usual type cannot be applied to these problems for rather obvious reasons. But most of the arguments against the application of reproduction costs to situations of this kind lose their force against a reproduction-cost basis computed by the use of index numbers. The reasons are similar to those presented above in the case of "standby" properties.

Land in the rate base.—One of the most widely disputed points in connection with the use of reproduction costs is the selection of the proper basis for inclusion of land in the rate base. While usually not an important item in utilities other than railroads, it is nevertheless sometimes of considerable importance.

Since the present discussion relates primarily to the valuation of depreciable property, land, ordinarily a non-depreciating item, is accorded here a very brief and summary treatment. For the valuation of land three bases have been suggested:

1. At cost. Land is not reproducible, nor salable apart from the business which operates on it, and there is therefore no tangible basis for appraisal except cost. In the case of much of the land used for public-utility operation there is no alternative property, nor perhaps any similar property adjacent.

2. At the present price of similar adjacent land. This is a common basis for appraising land for many other purposes, and is an approxi-

[4] J. Bauer, *Effective Regulation of Public Utilities* (New York, 1925), pp. 225–27.

mate measure of what would have to be paid for the identical property in question now.[5]

3. At an amount representing the actual price paid, adjusted by an index number—either a general-price index number or the special utility-construction cost index number already described.

It is generally agreed that there is normally a long-time increment in the value of land, aside from changes in general price levels. It is argued that this increment must be allowed to investors in regulated industries, for such increment naturally accrues in competitive industries and without it capital will not flow freely into the public-utility field. It is further argued that the development of the public utility itself causes an increment in adjacent land values, and that a corresponding increment should be recognized in its own land.

A critical analysis of these statements and of their implications leads to the following conclusions: Any predictable increment in land values, other than that to be created by the public-utility company itself, is discounted in advance and paid for by the company at the time of purchase. Any increment that has accrued should probably be allowed now to present investors, for presumably their investments have been made on the basis of that expectation (following the trend of recent rulings of courts and commissions). So far as new capital is concerned, a decision that predictable increment to accrue as the result of public-utility development will not be included in the rate base in the future would probably increase slightly the cost of new capital. A decision to include, or not to include, unpredictable future increment (or decrement) should have no effect whatsoever on the cost of capital or on the ease with which it may be secured.

The most logical solution to this problem is probably that land should be included in the rate base on the same basis selected for the other assets. However, due to the peculiar problems inherent in estimating the reproduction cost of land already devoted to public-utility operation (as described above) the most practicable method, perhaps, is to approximate a type of reproduction cost by applying an index number to the actual purchase price paid for the land when it was

[5] From a somewhat different point of view the value of utility land—not salable, or reproducible, or usable for any other purpose—is not the same as that of adjacent land. Its value really depends on earnings—therefore on rates—therefore on the "value" assigned to it—the amount allowed for it in the rate base.

originally acquired by the public utility. The merits of this method applied to land are similar to those already discussed in connection with "standby" plants.

Incentives for efficient management.—It has been pointed out that under an original-cost basis of depreciation and of rate-base determination (if we assume prompt adjustment of rates to changing conditions of cost) there is small incentive to the most efficient methods of operation.[6] Under the reproduction-cost basis one incentive only is added—the incentive to select low-cost periods for construction in order to benefit from a higher rate of return in subsequent higher cost periods. But only under the reproduction-cost-of-service basis is there found an incentive to make technological progress in the industry, to use the best possible methods, to select the most efficient type of plant and equipment; and this basis has already been ruled out on the grounds of impracticability.

It must surely be possible, even in a strictly regulated industry, to offer some sort of premium for efficiency of operation. It was suggested earlier that the use of methods or equipment seriously obsolete should be penalized by allowing only rates necessary to cover the estimated costs of more modern methods. But at the same time it was pointed out that the application of this principle was impracticable except in the most extreme cases. It is therefore imperative to find some other and more practicable method, some definite, easily computed, standards of performance for each type of public-utility service against which actual performance can be checked. Variations from these standards can then be rewarded or penalized by allowing higher or lower rates of return.

[6] At the present time, under both original and reproduction cost bases, there is unwittingly granted temporarily a sort of a premium for efficiency, due solely to the difficulties and delays incident to the changing of service rates when once they are established. Because of this fact, any saving made by the public utility company in its operation after the rates have been set, serves to increase its return, temporarily, until the rates are adjusted again. Unfortunately, these savings are commonly made the basis for a subsequent decrease in rates which secures a final saving to consumers only, with no permanent benefit to investors. In fact, these economies will operate as a detriment to investors unless they are continued in subsequent periods, for the adjusted service rates are established in anticipation of the continuance of those savings; any decrease in these economies, therefore, must come out of the investors' return, until another adjustment of rates can be effected.

The "performance" of a public utility, it would seem, must be measured largely on the basis of the service rates charged to its consumers.[7] Other things being equal, "good performance" is indicated by relatively low service rates and "poor performance" by relatively high service rates. Of course "other things" are *not* equal; differences in operating costs in different localities and in plants of different sizes must be taken into consideration. But when standards of performance have been determined which make allowance for these variables then service rates above or below these standards will provide the basis for allowing respectively a higher or lower rate of return to investors.[8] Such a plan offers a real incentive to public-utility operators.

But at this point consumers may raise questions: Should all such savings go to investors? Should not a substantial allowance be made for so-called "progress in the art"? And should not consumers receive the benefit from such decreases in cost as are common to a majority of the producers in the industry? The answer seems obvious; consumers *should* receive a benefit in the form of lower costs from all progress common to the industry. Some provision must be made, therefore, for a flexible standard, a shifting, but definitely ascertainable standard, a "fair" basic service rate against which to check the actual service rates charged by the various producers in the industry. The following is presented as one possible method of arriving at such a standard.

First, prepare an index or average of rates actually charged currently for public-utility services, classified by types of service, by type of locality, by size of company, etc. This index must be prepared periodically.

Second, determine the relation which the present service rates of the company in question bear to this average or index.

Third, reward with a higher return (or penalize with a lower return) any change which this company makes in its own rates, relative to

[7] There are, of course, many other factors which should enter into a measure of the "performance" of a public utility, such as quality, reliability, and safety of the service. It is desirable that these factors be included in the determination of "standard" performance, and in the evaluation of actual service rendered, if there be any practicable and definite method of doing so.

[8] A premium for efficiency has been included in many contracts between cities and public-utility companies. For example, the city of Washington, in its contract with the electric light and power company, provides that dividends may be increased in proportion as the rates for electricity are reduced.

changes in the average rate—the index (subject, possibly, to the limitation that a certain minimum standard of performance relative to the average must be attained before any premium is allowed).

It is not maintained that this is a perfect solution to the problem, but if the standards are set carefully, if performance is checked accurately, and if only a part of the savings are included in the "premium" to utility investors, both consumers and investors will benefit from the plan. It should be noted that only as progress is made that exceeds "the average in the industry" is there any premium allowed, that a lesser progress than this is penalized, and that all benefits of progress attained by the whole industry accrue to consumers. The most unfair feature of the plan, perhaps, is that progress to date, up to the time of the institution of the plan, may forever remain unrewarded. But if the purpose of the plan be conceived as the attainment of future increase in efficiency of operation, its objective should be achieved.

CHAPTER IX

ACCOUNTING PRINCIPLES—CONCLUSIONS

In previous chapters it has been demonstrated that from the point of view of both public-utility investors and consumers the most equitable basis for the annual depreciation charge is current reproduction cost, and that the proper basis for rate-base determination is reproduction cost less the percentage of accrued depreciation that has been charged into the operating expense of prior periods. The accounting treatment for the application of these principles is discussed below.

The first point at issue is the extent to which revaluations of properties from period to period should be reflected in the accounting records proper. It is here suggested that to treat them in this manner would complicate unnecessarily the routine accounting procedures. It would seem better practice to maintain the property accounts at original cost, to accumulate in the "regular" depreciation reserve an amount of depreciation based on these original costs, and to accumulate in a "special" depreciation reserve the excess depreciation resulting from the use of reproduction costs as the base. (It is apparent that this "reserve" may have a debit or credit balance, depending upon whether reproduction costs are [and have been] more or less than original costs.)

In addition, it is probably the best practice to create a single additional reserve for obsolescence by charges into operating expense. Also, there should probably be created a reserve for repairs and maintenance for each group of similar assets, or a single reserve for all assets, set up also by charges into operating expenses. These last two reserves, however, are equally appropriate under original-cost and reproduction-cost bases of depreciation.

If this procedure is followed the property accounts and the "regular" depreciation reserves will always reflect the percentage of original cost which has been charged into operations, and will, therefore, furnish the information as to the percentage of reproduction costs (new) which should be deducted as accrued depreciation.[1] Assets retired are charged

[1] It must be noted that the total "regular" depreciation reserve related to the total original costs of all properties may not measure accurately the percentage of expired service life, the percentage of reproduction cost (new) to be deducted from

against the regular depreciation reserve to the extent of the accrued depreciation at original cost; any undepreciated balance, less salvage, may be charged against the reserve for obsolescence, if such a reserve has been created—otherwise to "property abandoned" or to surplus. Replacements—or additional properties—are charged to the property accounts at their new costs. The credit balance in the special depreciation reserve indicates a source of the investment in replacements over the cost of assets retired. A debit balance is an offset against capital accounts, indicating a shrinkage in dollar (money) capital—because of lower price levels and higher purchasing power per dollar of the capital remaining.

To illustrate this procedure the case on page 60 is analyzed in terms of book accounts. At the end of the tenth year there is a total of $3,774,000 in the properties account.[2]

In the "regular" depreciation reserve is a balance of $2,054,000, representing total accrued depreciation based on original costs.[3]

In the "special" depreciation reserve is a balance of $720,000, which represents the excess depreciation resulting from the use of reproduction cost as a base.[4]

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accrued depreciation. This percentage must be separately determined for each property item or separately for the total properties acquired in each year—at each price level—or the costs of all properties must be adjusted to the price level of a single base year before using the grand total figures. The fallacy of relating the total reserve to the total cost of properties, without adjustment, is demonstrated on pp. 73–74 ff.

[2] This amount is subject to retirements which may have been made, credited to this account, charged to the regular depreciation reserve to the extent of the depreciation charged off prior to retirement, and any undepreciated balance charged against a reserve for obsolescence, or perhaps, to a "property abandoned" account.

[3] The balance also may have been reduced by retirements, as described in the foregoing footnote.

[4] A closer analysis shows that actually $1,120,000 has been collected in depreciation charges that would not have been collected under actual costs. The additional $400,000 has been caused by depreciation on the original costs of assets which were purchased out of "excess" depreciation during prior years. If depreciation had been charged consistently on an original cost basis, and only depreciation charges reinvested in properties, the property account balances would be $2,654,000 and the depreciation reserves only $1,654,000. Of course more properties are "used and useful" in the service than would be the case if original costs had been the basis for depreciation, and the $400,000 is therefore really a charge for the use of additional properties, while the $720,000 is an additional charge because price levels are higher.

Determination of the rate base.—There are several correct methods for determining the rate base for 1932. The method selected depends on the information available in the accounts. By one method the total cost of the properties, adjusted to the price base of the first or "base" year (100), is reduced by the total accrued depreciation computed on original costs adjusted to the same base, and the book value thus determined, $1,000,000 is multiplied by the index number of 1932 (148) to secure the reproduction cost less the percentage of accrued depreciation, $1,480,000. A second method of determining the rate base is to use these same base figures to determine the percentage of accrued depreciation:

$$\frac{\$1,654,000}{\$2,654,000} = 61.94 \text{ per cent} = \text{accrued depreciation}$$

This percentage of accrued depreciation is deducted from the reproduction cost (new) of the properties, however determined:

$\$3,926,000 - (\$3,926,000 \times 61.94 \text{ per cent}) = \$1,480,000 = $ rate base at the end of 1932.

Still a third method is to analyze the properties according to the year in which purchased, adjust them to current reproduction costs, determine the percentage of accrued depreciation on each group of properties, and accumulate a total of reproduction cost (new) and of accrued depreciation to date.

An error frequently made in determining the rate base is to assume that for the total assets, acquired in periods of different price levels, total depreciation charges based on original costs represent the *percentage* of expired service-life value of the total assets. This fallacy is illustrated by the case just described. Total asset values at the end of the tenth year, $3,774,000, divided into total depreciation charges at cost, $2,054,000, gives an accrued depreciation of 54.4 per cent. This percentage applied to the reproduction cost (new) of $3,926,000, determines a rate base of $1,790,000, obviously an inaccurate figure.[5]

Table V illustrates accurate and inaccurate methods of determining the percentage of expired service—the percentage of accrued depreciation

[5] The mathematical explanation of this fallacy lies in the fact that unequal weights are assigned to price levels—more assets are purchased at some price levels than at others, and in comparing total costs with total accrued depreciation at cost the effect of this irregular weighting appears.

tion to be deducted from reproduction costs (new) in determining the rate base.

TABLE V

DETERMINATION OF PERCENTAGE OF ACCRUED DEPRECIATION ON REPRODUCTION COST

(Accurate and Inaccurate Methods)

Year of Purchase	Index of Reproduction Cost	Index of Physical Quantities Added Each Year	Additions at Actual Cost	Total—End of Year at Cost	Depreciation 10 Per Cent of Cost	Reproduction Cost—End of Fifth Year	Percentage of Accrued Depreciation End of Fifth Year	Accrued Depreciation Fifth Year—Adjusted to First-Year Base	Accrued Depreciation Fifth-Year Reproduction Cost	Rate Base Fifth Year Reproduction Cost Less Depreciation
1.....	100	100	$ 100	$ 100	$ 10	$ 140	50	$ 50	$ 70	$ 70
2.....	110	200	220	320	32	280	40	80	112	168
3.....	120	300	360	680	68	420	30	90	126	294
4.....	130	400	520	1,200	120	560	20	80	112	448
5.....	140	500	700	1,900	190	700	10	50	70	630
Total..	.....	1,500	$1,900	.....	$420	$2,100	.....	350	490	1,610

Percentage of Accrued Depreciation:

Accurate Methods:

1. $\frac{\text{Total Depreciation Adjusted to Base Year}}{\text{Total Cost Adjusted to Base Year}} = \frac{\$350}{\$1,500} = 23.33\frac{1}{3}$ per cent

2. $\frac{\text{Total Depreciation Adjusted to Current Repr. Cost}}{\text{Total Current Reproduction Cost}} = \frac{\$490}{\$2,100} = 23.33\frac{1}{3}$ per cent

Inaccurate Method:

3. $\frac{\text{Total Depreciation at Cost}}{\text{Total Cost}} = \frac{\$420}{\$1,900} = 22.105$ per cent

Rate Base = $\$2,100.00 \times (100 \text{ per cent} - 23.33\frac{1}{3} \text{ per cent}) = \$1,610.00$

In the foregoing case it is obvious that the amount of the rate base as determined by methods 1 and 2—$1,610—is correct for the result agrees with the total of the last column; method 3, though sometimes used in practice, is not accurate from the standpoint of holding uniform the "purchasing power" of the original and subsequent investments.

"Model" accounting plan.—In terms of the discussion to this point a "model" accounting plan for public-utility depreciation rate-base determination may be outlined as follows:

1. Properties acquired to be entered in the accounts at their original costs, these accounts *not* to be adjusted to reflect changes in price levels.
2. Periodic depreciation charges based on current reproduction costs (new) and expected service life (with allowance for salvage) to be computed preferably by the compound-interest method in order to get a uniform "real" cost of depreciation and a fair return; though practical considerations, including ease of computations, probably justify the straight-line method.
3. Of the amount charged periodically for depreciation, the part based on original costs to be credited to the "regular" depreciation reserve; any excess (or deficiency) of depreciation due to the use of the reproduction-cost base to be credited (or charged) to a "special" reserve for depreciation.
4. Accruing repairs and maintenance, based on current prices in the period of accrual, to be provided for by charges to expense and the creation of a reserve, actual expenditures for repairs to be charged to this reserve when they occur.
5. Obsolescence to be provided for by charges to expense and the creation of a single obsolescence reserve for all properties—or a very few reserves for groups or classes of properties.
6. In case of retirements, the original cost of the property to be credited to the property account, the accumulated depreciation to be charged to the "regular" depreciation reserve, and the undepreciated balance, less salvage, to be charged to the reserve for obsolescence.
7. Replacements of or additions to properties to be added to the property accounts at their actual costs.
8. The rate base for determination of fair return to be the current reproduction cost (new) of the properties "used and useful," less the percentage of depreciation which has been or should have been previously written off into operating expense of prior periods, less also the balance in the obsolescence reserve (adjusted to reproduction costs if practicable); there may be deducted, also, perhaps, the balance in the reserve for repairs and maintenance, although the last item may perhaps better be treated as a liability reserve.
9. Current reproduction cost to be determined by index numbers of construction costs, classified by types of utilities by localities, and subclassified, perhaps, by types of properties; these indexes to be prepared by a *central* co-operative agency, carefully and *promptly*.

10. A premium for efficiency may be provided by adjustment of the fair rate of return.
11. The cumulative (multiple) effect on common stockholders of changes in price levels may be reduced by changes in financial structure to decrease the proportion of fixed-return investment, or by the creation of an equalization reserve whereby only a part of the excess earnings of high-price periods are paid out in dividends and a part are conserved as a "shock-absorber" for decreased earnings in low-price periods.

Conclusions.—The results of this accounting and "valuation" program may be summarized as follows:

1. For the investors (as a group):
   a) A more uniform "real" income (subject to differentials between general prices and public-utility construction costs).
   b) A more uniform and unchanging investment (in terms of purchasing power). (That the large percentage of fixed-return investment in the utility field modifies these conclusions with respect to individual investors and classes of investors has already been noted.)
2. For the customers:
   a) A more constant "real" cost per unit of service, a cost that reflects current market costs—a "competitive" cost.
   b) A more constant balance between the relative advantages of public-utility services and alternative services.
3. Other advantages:
   a) A more exact and definite basis for computing depreciation and for determination of the rate base, and consequent decrease of delay, uncertainty, and litigation.
   b) An incentive for construction in low-cost periods with consequent decreases in costs to customers, and/or increases in returns to investors.
   c) A "leveling" effect on the business cycle, for two reasons:
      (1) More public-utility construction in low-cost periods and less in high-cost periods (see *b* above and *c*(2) below).
      (2) A decrease, relatively, in high-price periods, in the demand for utility service and for construction due to increasing service rates; conversely, an increase, relatively, in low-price periods due to decreasing service rates.
   d) Elimination of errors in industrial or residential location caused by temporary "artificial" advantages or disadvantages in rates for public utility service—"artificial" in the sense that the rates are based on original cost of properties "used and useful" in the service.

Opinion of regulatory bodies.—Up to the present time there are not a great number of commission and court decisions to support depreciation charges based on current reproduction costs. It would appear that regulatory bodies are not entirely consistent when they adopt reproduction costs for the determination of the rate base and at the same time use original costs as the basis for the depreciation charge. Hundreds of cases may be cited to support original costs as the proper depreciation base, but there are a few recent and rather important cases which have sanctioned the use of reproduction costs.

The majority of the United States Supreme Court (Brandeis and Holmes dissenting) expressed themselves in a recent case as follows:

> Manifestly this allowance cannot be limited by the original cost, because if values have advanced, the allowance is not sufficient to maintain the level of efficiency. The utility is entitled to see that from earnings the value of the property is kept unimpaired so that at the end of any given term of years the original investment remains as it was at the beginning (*Knoxville* v. *Knoxville Water Co.*, 212 U.S. 1, 13–14). This naturally calls for expenditures equal to the cost of the wornout equipment at the time for replacement; and this, for all practical purposes, means present value. It is the settled rule of this court that the rate base is present value, and it would be wholly illogical to adopt a different rule for depreciation.[6]

The Supreme Court of Michigan also supports this view:

> If the rate base is present fair value, then the depreciation base as to depreciable property is the same thing. There is no principle to sustain a holding that a utility may earn on the present fair value of its property devoted to the public service, but that it must accept and the public must pay depreciation on book cost or investment cost regardless of present fair value. We repeat, the purpose of permitting a depreciation charge is to compensate the utility for property consumed in service and the duty of the commission, guided by experience in rate-making is to spread this charge fairly over the years of the life of the property.[7]

It should be noted, however, that in the United Railways Case (referred to above) the dissenting opinion of Justice Brandeis has been widely quoted as an exceptionally able defense of the original-cost basis for the annual depreciation charge. State commissions have voiced op-

[6] *United Railways and Electric Company of Baltimore* v. *West et al.*, 280 U.S. 234.

[7] *Michigan Public Utilities Commission* v. *Michigan State Telephone Company*, 228 Mich. 658, 666.

position to the majority ruling, and the New York Public Service Commission has flatly refused to follow the Supreme Court's ruling in this case, and other commissions have followed suit. The prevailing opinion of courts and commissions is still in favor of the original-cost basis. But "Granting its utility, no business rule or principle, however time-honored, can continue indefinitely to ignore economic law and survive . . . . we are faced with a condition that is testing a time-honored rule (that of basing depreciation on original cost) to the breaking point.[8]

[8] H. G. Baldwin, *Accounting for Value as Well as Original Cost*, pp. 5–6.

APPENDIX

DEPRECIATION METHODS

There are available in current publications so many excellent discussions of the relative merits of the various methods of computing depreciation that the question will not be discussed at length here.[1]

However, in order to furnish a background for a study of the effect of the depreciation method used upon costs to consumers of public-utility services and upon the returns to utility investors there is presented in Table VI the application of each of three methods to a very simple hypothetical case.

The three methods illustrated are:

1. The *straight-line method* which consists in spreading the cost of the asset (less salvage), by equal periodical charges to operating expense, over its service life.
2. The *sinking-fund method*, which assumes the existence of a fund for replacement of assets, although in actual practice the amounts collected for depreciation would be reinvested in additional properties. Under this method equal charges are made to operating expense each period, but only in such an amount that their accumulation at a specified rate of compound interest will equal the cost of the asset (less salvage) at the time of its retirement.
3. The *compound-interest method*, which spreads the cost of the asset (less salvage) over its service life by constantly increasing charges to operating expense. The amount of the initial charge is the same as that under the sinking-fund method but in each succeeding period there is added to the amount of this initial charge the periodic interest (imputed or actual) on all previous additions to the depreciation reserve.

In Table VI is illustrated the result of the application of each of these three methods to properties which cost $100,000, with an esti-

[1] For the reader who has a special interest in this subject the following references are suggested:

W. A. Paton, *Accountants' Handbook* (New York: Ronald Press, 1932), pp. 577–720; Public Service Commission of Wisconsin, *Depreciation* (New York: State Law Reporting Company, 1933); E. A. Saliers, *Depreciation—Principles and Applications* (New York: Ronald Press, 1922); D. F. Wilcox, *Depreciation in Public Utilities.* (New York: National Municipal League, 1925).

TABLE VI

Comparison of Depreciation Methods

Year	Depreciation Reserve Additions					"Fair Return" on Rate Base			Combined Charges for Depreciation and "Fair Return"		
	Straight-Line Method by Charges to Expense	Sinking-Fund Method			Compound-Interest Method—by Charges to Expense	Straight-Line Method Cost Less Accrued Depreciation	Sinking-Fund Method Undepreciated Cost	Compound-Interest Method Cost Less Accrued Depreciation	Straight-Line Method	Sinking-Fund Method	Compound-Interest Method
		By Charges To Expense	By Interest on Accumulations	Total							
1	$ 10,000	$ 7,587	.....	$ 7,587	$ 7,587	$ 6,000	$ 6,000	$ 6,000	$ 16,000	$ 13,587	$ 13,587
2	10,000	7,587	$ 455	8,042	8,042	5,400	6,000	5,545	15,400	13,587	13,587
3	10,000	7,587	937	8,524	8,524	4,800	6,000	5,063	14,800	13,587	13,587
4	10,000	7,587	1,458	9,045	9,045	4,200	6,000	4,542	14,200	13,587	13,587
5	10,000	7,587	1,990	9,577	9,577	3,600	6,000	4,010	13,600	13,587	13,587
6	10,000	7,587	2,566	10,153	10,153	3,000	6,000	3,434	13,000	13,587	13,587
7	10,000	7,587	3,174	10,761	10,761	2,400	6,000	2,826	12,400	13,587	13,587
8	10,000	7,587	3,820	11,407	11,407	1,800	6,000	2,180	11,800	13,587	13,587
9	10,000	7,587	4,505	12,092	12,092	1,200	6,000	1,495	11,200	13,587	13,587
10	10,000	7,587	5,225	12,812	12,812	600	6,000	775	10,600	13,587	13,587
Total	$100,000	$75,870	$24,130	$100,000	$100,000	$33,000	$60,000	$35,870	$133,000	$135,870	$135,870

TABLE VII

Depreciation and Fair Return on Reproduction Cost Basis
Compound Interest Method of Depreciation

Year Ended	P. U. Construction-Cost Index	Property Account End of Year			Depreciation 6 Per Cent Compound-Interest Method Reproduction Cost	Accrued Depreciation Reproduction Cost	Rate Base Reproduction Cost Less Accrued Depreciation	Fair Return 6 Per Cent on Rate Base	Depreciation and Fair Return	Divided by Index and Physical Amount of Property
		Original Cost	Adjusted 1913 Base	Reproduction Cost						
1912.....	.....	$1,000.00	$1,000.00	$1,000.00	.....	.....	.....	.....	.....	.....
1913.....	100	1,027.18	1,027.18	1,027.18	$ 27.18	$ 27.18	$1,000.00	$ 60.00	$ 87.18	0.0872
1914.....	98	1,056.15	1,056.74	1,035.61	28.97	55.61	980.00	58.80	87.77	.0872
1915.....	101	1,088.61	1,088.88	1,099.77	32.46	89.77	1,010.00	60.60	93.06	.0872
1916.....	121	1,130.86	1,123.80	1,359.80	42.25	149.80	1,210.00	72.60	114.85	.0872
1917.....	154	1,189.36	1,161.79	1,789.16	58.50	249.16	1,540.00	92.40	150.90	.0872
1918.....	175	1,261.63	1,203.09	2,105.41	72.27	355.41	1,750.00	105.00	177.27	.0872
1919.....	191	1,347.36	1,247.97	2,383.62	85.73	473.62	1,910.00	114.60	200.33	.0872
1920.....	227	1,458.12	1,296.76	2,943.65	110.76	673.65	2,270.00	136.20	246.96	.0872
1921.....	202	1,565.30	1,349.82	2,726.64	107.18	706.64	2,020.00	121.20	228.38	.0872
1922.....	180	1,669.12	1,407.50	2,533.50	103.82	733.50	1,800.00	108.00	211.82	.0872
1923.....	183	1,783.89	1,470.22	2,690.50	114.77	860.50	1,830.00	109.80	224.57	.0872
1924.....	181	1,907.31	1,538.41	2,784.52	123.42	974.52	1,810.00	108.60	232.02	.0872
1925.....	179	2,039.97	1,612.52	2,886.41	132.66	1,096.41	1,790.00	107.40	240.06	.0872
1926.....	178	2,183.40	1,693.10	3,013.72	143.43	1,233.72	1,780.00	106.80	250.23	.0872
1927.....	175	2,336.77	1,780.74	3,116.30	153.37	1,366.30	1,750.00	105.00	258.37	.0872
1928.....	176	2,504.41	1,875.99	3,301.74	167.64	1,541.74	1,760.00	105.60	273.24	.0872

TABLE VII—*Continued*

Year Ended	P. U. Construction-Cost Index	Property Account End of Year			Depreciation 6 Per Cent Compound-Interest Method Reproduction Cost	Accrued Depreciation Reproduction Cost	Rate Base Reproduction Cost Less Accrued Depreciation	Fair Return 6 Per Cent on Rate Base	Depreciation and Fair Return	Divided by Index and Physical Amount of Property
		Original Cost	Adjusted 1913 Base	Reproduction Cost						
1929.....	179	2,689.77	1,979.54	3,543.38	185.36	1,753.38	1,790.00	107.40	292.76	.0872
1930.....	172	2,883.38	2,092.10	3,598.41	193.61	1,878.41	1,720.00	103.20	296.81	.0872
1931.....	162	3,081.65	2,214.49	3,587.47	198.27	1,967.47	1,620.00	97.20	295.47	.0872
1932.....	148	3,278.60	2,347.56	3,474.39	196.95	1,994.39	1,480.00	88.80	285.75	0.0872
(1)	(2)	(3) $1,000.00 +Col. (6) Accumulated	(4) Col. (3) Adjusted by Index	(5) Col. (2) ×Col. (4)	(6) From Table VIII	(7) Col. (4) −$1,000 ×Col. (2)	(8) Col. (5) −Col. (7)	(9) Col. (8) ×6 Per Cent	(10) Col. (6) +Col. (9)	(11) Col. (10) / Col. (2)×Col. (4) of Prior Year

mated service life of ten years, and with no salvage value at retirement. An interest rate of 6 per cent is used in all computations, including the "fair return."

In order to demonstrate that under the compound-interest method or sinking-fund method the combined "real" charge for depreciation and fair return is a constant amount for a specific quantity of fixed assets, a further illustration is presented below. In this case assets costing $1,000, with an estimated life of twenty years, are acquired at the end of 1912. During the next twenty years depreciation is computed by the 6 per cent compound-interest method, on the current reproduction cost of the assets as indicated by the public-utility construction-cost index number, previously described.

All amounts collected for depreciation are reinvested in additional properties during the current year. Each year the allowed fair return of 6 per cent is based on current reproduction cost less the accrued percentage of depreciation.

The results of the application of this method of depreciation and rate-base determination are presented in Table VII.

The final column (11) in Table VII indicates a constant annual "real" charge of $87 for depreciation and fair return for each "block" of physical properties costing (on the 1913 base) $1,000 new. This amount is determined for each period by dividing the combined charge for depreciation and fair return by the dollar cost new (on 1913 base) of the assets in use during the year, adjusted by the construction cost index number for that year. For example, the figure for 1932 is determined as follows:

$$\frac{\$285.75}{\$2214.49 \times 148} = .0872 .$$

Complexity of compound-interest method.—The computations incident to the preparation of Table VII are further evidence of the complexity of the compound-interest or sinking-fund methods of depreciation. For the assets acquired each year a new series of depreciation charges must be computed. Table VIII presents only the first few columns of a forty-column table necessary merely to accumulate these depreciation charges by the compound-interest method applied to a reproduction-cost base. More than 1,000 computations were required.

TABLE VIII

DEPRECIATION—6 PER CENT COMPOUND INTEREST METHOD
REPRODUCTION-COST BASE

YEAR ENDED	P. U. CONSTRUCTION-COST INDEX	DEPRECIATION COST ON ORIGINAL $1,000	DEPRECIATION ON REPRODUCTION COST	DEPRECIATION ON REINVESTMENTS OF DEPRECIATION					
				Cost 1913	Reproduction Cost	Cost 1914	Reproduction Cost	Cost 1915	Reproduction Cost
				(Cost = $27.18)		(Cost = $28.97)		(Cost = $32.46)	
1913	100	$27.18	$ 27.18	.....	.....	.....	.....	.....	.....
1914	98	28.82	28.24	$0.74	$0.73	.....	.....	.....	.....
1915	101	30.54	30.85	78	0.79	$0.79	$0.82	.....	.....
1916	121	32.38	39.18	.83	1.00	.83	1.02	$0.88	$1.05
1917	154	34.32	52.85	.88	1.36	.88	1.39	.94	1.44
1918	175	36.38	63.67	.93	1.63	.94	1.68	0.99	1.71
1919	191	38.56	73.65	0.99	1.89	0.99	1.93	1.05	1.99
1920	227	40.87	92.77	1.05	2.38	1.05	2.43	1.11	2.50
1921	202	43.33	87.53	1.11	2.24	1.12	2.31	1.18	2.36
1922	180	45.93	82.67	1.18	2.12	1.18	2.16	1.25	2.23
1923	183	48.68	89.08	1.25	2.29	1.26	2.36	1.33	2.41
1924	181	51.60	93.40	1.32	2.39	1.33	2.46	1.41	2.52
1925	179	54.70	97.91	1.40	2.51	1.41	2.57	1.49	2.64
1926	178	57.98	103.20	1.49	2.65	1.50	2.72	1.58	2.78
1927	175	61.46	107.56	1.58	2.77	1.58	2.83	1.68	2.91
1928	176	65.15	114.66	1.67	2.94	1.68	3.02	1.78	3.10
1929	179	69.06	123.62	1.77	3.17	1.78	3.26	1.88	3.34
1930	172	73.20	125.90	1.88	3.23	1.89	3.32	2.00	3.41
1931	162	77.59	125.70	1.99	3.22	2.00	3.31	2.11	3.39
1932	148	82.25	121.73	2.11	3.12	2.12	3.20	2.24	3.29
(1)	(2)	(3)	(4) Col. (3) × Col. (2)	(5)	(6) Col. (5) × Col. (2)	(7)	(8) $\frac{\text{Col. (7)} \times \text{Col. (2)}}{98}$	(9)	(10) $\frac{\text{Col. (9)} \times \text{Col. (2)}}{101}$

It must be noted further that only twenty-year assets are included in the illustration above. In actual practice there would be assets of varying life, and for each age group the computation described above must be duplicated. It is small wonder that public-utility accountants avoid where possible the use of compound-interest methods. The fact remains that *only* by this method can be achieved a uniform cost per period for depreciation and fair return. And *only* by the use of the reproduction-cost base can a uniform "real" cost of these factors be secured.

General conclusions—depreciation methods.—The following conclusions may be drawn from the results of the foregoing computations:

1. The straight-line method results in a gradually decreasing combined charge for depreciation and "fair return"; early periods are burdened more heavily than later periods for the full cost of using a specific physical quantity of assets.

2. Both the sinking-fund method and the compound-interest method result in the same uniform cost each period for depreciation and "fair return" combined, for each property unit.

3. The equitable application of the sinking-fund method demands that accrued depreciation be *not* deducted from the rate base in the computation of a fair return. Another method of accomplishing the same result is to *exclude* from "allowed income" the earnings on all funds or additional assets which are acquired out of amounts collected through depreciation charges computed by the sinking-fund method.

4. The sinking-fund method is "cheaper" only in the sense that amounts actually charged to operating expense are less than under other methods. The larger rate base and consequently larger allowance for fair return balances this factor.

5. Total depreciation and fair-return charges for the whole life of the property are less under the straight-line method than under other methods, but the larger amounts are charged in early periods. It can be demonstrated that to *total* consumers and to *total* investors the choice of depreciation method is immaterial, if money is worth 6 per cent (or other interest rate) to all parties concerned. It is only *successive* consumers and investors that the choice of methods may affect favorably or adversely.[2]

Depreciation based on earnings or volume.—It is not unusual to find, in public-utility accounting, charges for depreciation based on volume of service rendered or on gross earnings. The use of such a method is merely a matter of apportionment among accounting periods. It is equally applicable (if at all) under the principle of original costs or of reproduction costs. The *total* amount to be recovered is not the question at issue; the principle involved is purely a matter of whether or not "lean" years, merely because of the fact that they are "lean" years, should therefore be charged with less depreciation cost.

From the standpoint of pure theory there is much to be said in favor of gross revenue as a basis for annual depreciation charges. In the final analysis fixed properties are consumed to produce revenues, and why, therefore, should not the expiration of their service life be charged against operating periods in proportion to the extent to which they per-

[2] For an opinion favoring the straight line method see *Michigan Bell Telephone Co.* v. *Odell*, 45 F. (2d) 180. For an opinion favoring the sinking-fund method see *Re Wisconsin Telephone Co.* (Wis.) P.U.R. 1925 D, 661. For a discussion of both methods see *Re Elizabethtown Water Co.* (N.J.) P.U.R. 1927 E, 39.

form this their primary function? If it were possible to predetermine the total amount of gross or net earnings to be earned during the life of specific properties there would be no logical rebuttal to this argument. The difficulty lies, of course, in the fact that revenues cannot be estimated in advance with any great degree of accuracy. The cost (original or reproduction) of the properties must be written off during their service life, and in the absence of a basis more closely commensurate with their relative contribution to the accounting periods within this service life, the expiration of time is the most practicable basis for the apportionment of these costs, in the form of periodic depreciation charges into operating expense.

The composite life-method.—In actual practice depreciation is not computed on single assets individually, but on groups of assets, or on total assets, on a composite life-basis. For example, a single rate may be determined for four single assets as illustrated in Table IX (using the straight-line method).

TABLE IX

Unit	Cost	Estimated Life	Depreciation Rate (Per Cent)	Depreciation Amount
1.....	$ 5,000	10 years	10	$ 500
2.....	4,000	20 years	5	200
3.....	10,000	30 years	$3\frac{1}{3}$	333
4.....	8,000	40 years	$2\frac{1}{2}$	200
All units.....	$27,000	.....	4.57	$1,233

In the illustration in Table IX the correct composite rate is 4.57 per cent; the result secured by dividing the total annual depreciation, $1,233, by the total cost of the assets, $27,000. It is immediately apparent, of course, that any change in the composition of the assets that affects their average life must be reflected immediately in the composite rate.

Errors are made frequently in the application of the sinking-fund method or compound-interest method on a composite life-basis. This problem becomes particularly complicated as constant additions are made, either from reinvestment of amounts previously collected through depreciation charges or from new capital. It is probably true

that the principal reason for the limited use of these methods lies in the difficulty of application to complicated situations. The illustrative case on page 85, demonstrates admirably the amount of detailed computation incident to the accurate use of these methods.

It should be noted that the use of reproduction costs as a depreciation base does not complicate the composite life-method if price changes are uniform for all assets in each composite group. In such a case exactly the same composite rate may be applied accurately to the new base. However, if price changes are not uniform for all assets in the composite group a change in the composite rate may be necessary, for the effect of such a non-uniform price change is the same as that of a change in the relative life-composition of the assets, and adjustments of the same nature must be made.

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